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ABSTRACT

South Carolina has mountain chains, monadnocks, rolling hills, varying drainage patterns, rivers, a delta, barrier islands, rocks over a billion years old and land that was once part of another continent. This document contains a set of curriculum activities that have been developed from a diverse collection of aerial photographic, satellite, topographic, and special purpose mapping products available through a variety of sources. The maps were carefully chosen to provide spatial perspectives through a variety of map scales featuring geologic features in each of the state's five landform regions, namely, the Blue Ridge, Piedmont, Sandhills, Coastal Plain, and Coastal Zone. Within each of the landform regions, one or more individual study sites have been selected for detailed student activities. The lesson plan for each study site contains the following components: (1) "Power Thinking," a scenario designed to focus students' awareness of the region; (2) "Rationale"; (3) "Instructional Objectives"; (4) "Materials"; (5) "Background Information"; (6) "Activities"; (7) "Enrichment Activities"; (8) "Places to Visit"; and (9) "Reference and Resources." Sources of the various types of maps referred to in the units are listed. (CW)

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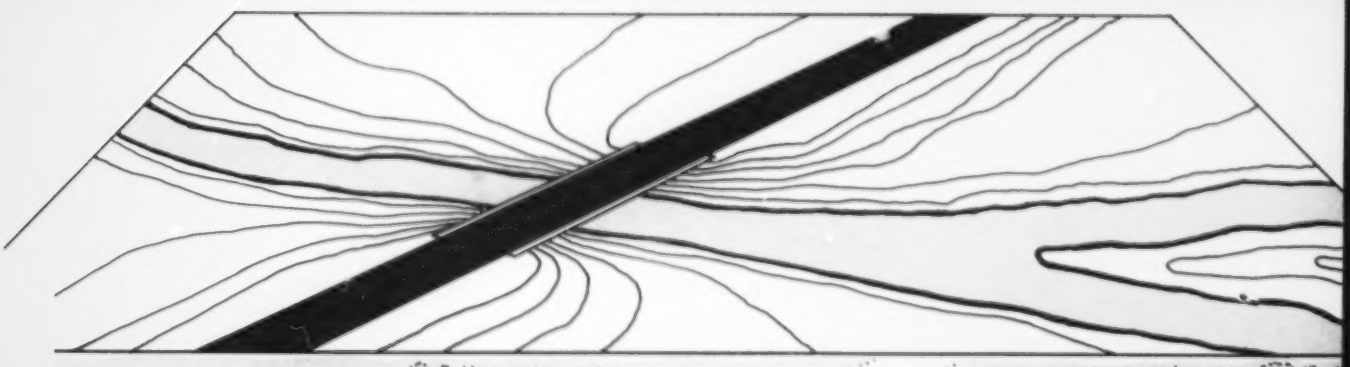
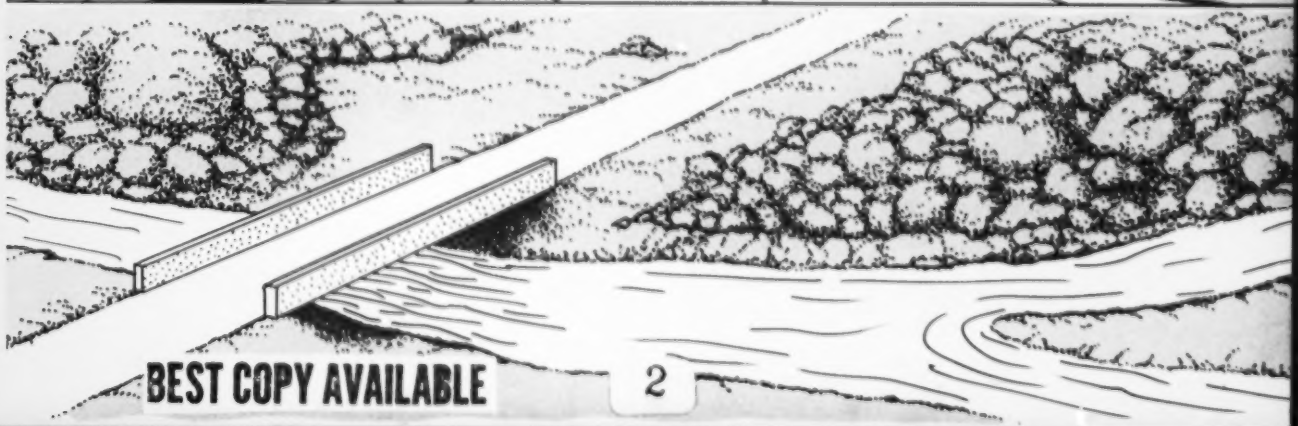
South Carolina Maps and Aerial Photographic Systems

South Carolina Department of Education





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SOUTH CAROLINA MAPS AND AERIAL PHOTOGRAPHIC SYSTEMS SC MAPS

Teaching Manual

May, 1990

Developed by

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SC MAPS Project is made possible with Title II Dwight D. Eisenhower Mathematics and Science Education Act (DEMSEA) funds for demonstration/exemplary programs.

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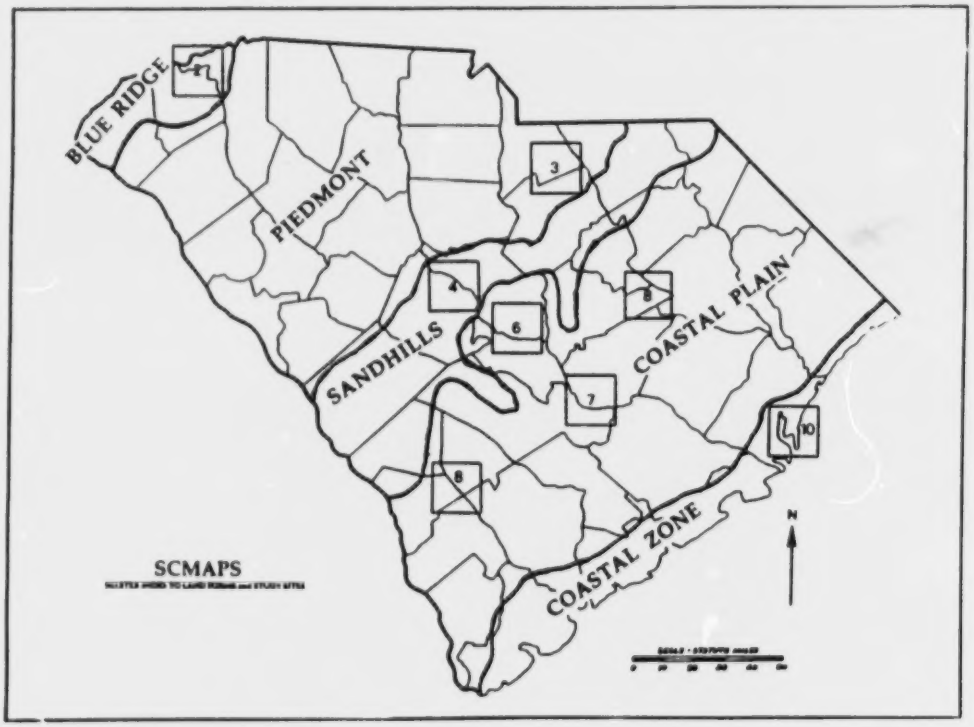

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PREFACE

Perhaps you like to go fishing in a nearby pond, duck hunting in the swamp, deer driving in the fall, hunting rabbits with your beagles, coon hunting at night, birding at the beach, white water rafting down the Chattooga River, swimming in the ocean, hiking to water falls in the mountains, skiing on a man-made lake, canoeing down the river, golfing on a rolling fairway, or walking through stately oaks on an old plantation. No matter where your interests may take you, the landscape of South Carolina is intriguing.

South Carolina's small size, 80,583 square kilometers, fortieth among fifty states has the greatest landform diversity and can brag on a fascinating geological as well as human history. There are few places on earth where one can watch the sun rise over the ocean in the morning, see the sun set in the mountains in the evening, and observe five distinct landform regions within one day.

Maybe you have wondered about the diversity of the state. Why do we have fast moving streams in the mountains and meandering rivers on the coast? Why do we have granite outcropping in the up state and flat fields in the low country? Why do we have flood plain swamps in the lower part of the state and water falls in the mountains? Why do we have sandy soils with marine fossils in Columbia which is over 100 miles from the ocean? Why are sea shells found in a Sumter County branch? Why did the early settlers grow rice in the intertidal zone? Why are the larger farms in the coastal plain area of the state? What brought many industries to the upper part of the state? What were the reasons for moving the Capitol to Columbia? These questions and many more will be answered through activities using infrared aerial photographs complemented with a variety of topographic and special purpose maps.

The diverse geological formations apparent by the landform regions have laid the pattern for the historical development of South Carolina. Each has its own fascinating story to tell. SC MAPS has attempted to show this interrelationship by recalling historical events that were shaped by the geological formations of the state.

INTRODUCTION & ACKNOWLEDGEMENTS

Premise for Developing SC MAPS

South Carolina has mountain chains, monadnocks, rolling hills, varying drainage patterns, rivers, a delta, barrier islands, rocks over a billion years old and land that was once part of another continent. A diversity in landform that is hard to match anywhere in the world.

Shouldn't South Carolina students be provided with the opportunity to see the relationship between geological formation and land use?

Shouldn't South Carolina students be able to recognize the historical and economic reasons for the locations of our cities, industries, and resort areas?

Shouldn't South Carolina students be able to recognize environmental issues and economic developmental trends?

Shouldn't South Carolina students be able to realize that it is the responsibility of all citizens to learn how to use and protect our natural resources?

It is with these premises in mind that SC MAPS was developed for the students of South Carolina, who will be our future lawmakers, business men and women, farmers, factory workers, teachers, builders, industrialists, and basically the keepers of the land.

Availability of Infrared Aerial Photographs

Using South Carolina maps to relate landform to land use began when Mr. Ned Owings, Science Coordinator, Florence School District 1 asked me to conduct an inservice program for earth science teachers in his district. Contact was immediately made with Mr. Chip Berry, Cartographic Specialist, at the South Carolina Land Resource Commission for information and resources that might be used for this inservice program. It was Chip who pointed out that infrared photographs and accompanying topographic maps of South Carolina were available through the National High Altitude Program (NHAP) and United States Geological Survey (USGS). A closer inspection of the Columbia NHAP photograph revealed details that could be used to identify and explain landform characteristics. Rapids on the Saluda and Broad Rivers made it easy to conceptualize that the Fall Line Zone was the dividing boundary between the Piedmont and the Sandhill regions of South Carolina. After a closer inspection of the river systems and drainage pattern of the central part of South Carolina, it became clear why the early transportation routes resulted in Columbia being selected for the Capital of the state. Furthermore, General William T. Sherman's choice of cannon placement site for bombardment of the State Capitol Building, near the end of the Civil War, made visual sense. Immediately it became apparent that these maps must be utilized as a useful teaching tool. Students must be given an opportunity to relate basic landform regions, historical development, and current land use patterns to the geological formation of South Carolina. It soon became apparent that Chip's enthusiasm for cartographic products was catching.

In addition, Chip outlined the variety of special purpose maps covering soil types, forest types, prime agricultural land, and land use. At the conclusion of this meeting both Chip and I were convinced that we must make these photographs and maps available to students through interesting classroom activities. We both realized that South Carolina's legacy of intriguing landscapes must become an important aspect of every student's background. Geological formations, historical event, landform features, and environmental concerns must be made relevant to each area of the state. Curriculum materials using cartographic products must be available for all South Carolina students.

Seed Funding Essential

Prior to the development of SC MAPS, the project had to be sanctioned by the Department of Education staff. The concept of using South Carolina aerial photographs and topographic maps for instructional purposes was readily approved by Mr. William B. Hynds, Chief Supervisor, Curriculum Development Section; Mr. Joel Taylor, Director of the Office of General Education; and Mr. Sidney B. Cooper, Deputy Superintendent, Instructional Division. Mr. John W. Parris, Executive Director, South Carolina Land Resources Commission also gave his support to the project. Without their stamp of approval, this project could never have been launched.

Funding was received through the Title II Education for Economic Security Act (EESA) allocations for implementation of demonstration and exemplary programs, while Mrs. Marjorie Claytor was administering the funds. The initial seed funding was used to purchase infrared photographs, transparencies, and accompanying topographic maps. Additional EESA allocations now called the Dwight D. Eisenhower Mathematics and Science Education Act under the direction of Dr. Shirley Sturgeon have provided the funds necessary for further development including purchase of the map sets, dissemination of the materials, and training workshops for teachers.

Committee Selects Study Sites

A committee was chosen to outline the overall design of the project and select study sites that were geologically significant to South Carolina. Dr. Ted Stankey, Department of Geography, University of South Carolina; Dr. Norman Olson, South Carolina State Geologist; and Dr. John Carpenter, Director, Center for Science Education, University of South Carolina along with Mr. Chip Berry and myself met to formulate a design and identify study sites that would enable us to utilize major thematic objectives of the project. Mr. Rudy Mancke, Naturalist, South Carolina ETV, also provided a wealth of excellent suggestions that were subsequently used. It was from these meetings that the study sites were selected and have remained the same throughout development of the materials. Soon after the study sites were selected, the process of selecting maps and writing the activities began with both Chip and I collaborating.

Second Committee Formed

Another committee was selected because of their direct involvement with students and teachers. Mrs. Martha Boswell, G/T Coordinator, Clarendon School District 2, reviewed the first draft of the project and gave many excellent suggestions. Professor John Wagner, Department of Earth Science, Clemson University became involved in writing the units and providing his knowledge of the geologic formation of South Carolina to enhance the materials.

Development of SC MAPS

Professor John Wagner began sending drafts from Clemson University focusing on the geological aspects of the study sites, while Chip provided an array of activity questions and problem solving situations for the booklet. The Power Thinking sections at the beginning of each study site were developed by Mr. Kevin Peter, Center for the Environmental Education at Seabrook Island with one exception. Major Scott Cain, F-16 Pilot at McEntire Air National Guard Base, wrote the Power Thinking activity at the beginning of Study Site 2. During the next few months, drafts of each study site were passed from John to me to Chip back to John back to me until we felt comfortable with the materials.

Pilot Teachers Field Test the Program

Before the project could be completed, Mr. Jim Mayer, Science Consultant, Oconee School District, field tested the Table Rock study site. He pointed out that, "parts of the SC MAPS curriculum materials could be used on a variety of grade levels." He also wrote a significant portion of the Preface outlining the stages of development. Jim kept reminding the authors of the need for students to enhance their geographic skills with South Carolina applications. His encouragement spurred the authors on to completion.

Five teachers agreed in September 1989, to pilot SC MAPS with their students. These teachers and their schools were Mrs. Martha Boswell, Manning Middle School; Mrs. Melba McKenzie, Estill Middle School; Mr. Jim Mayer, Oconee County School District; Mr. Giles Roberts, Southside Middle School; and Mrs. Karen Stratton, Fulmer Middle School attended the Briefing for SC MAPS held on September 20, 1989. Each pilot teacher received a set of the curriculum materials to use with their students. After critiquing the activities, reviews were written, and subsequent changes made to the document reflecting the recommendations of the pilot teachers. Mrs. Frances Crawford reviewed the Teaching Manual for technical errors.

Glimpses of South Carolina's Heritage

For the historical antidotes used throughout SC MAPS, Mrs. Margaret Walden, Social Studies Consultant, South Carolina Department of Education, provided many suggestions of interesting events that have shaped our heritage. These glimpses of our culture enhance the study of South Carolina history by relating the landform features to the historical and economic location of cities, industries, and resorts. Credit must also be given to Mr. Chip Berry who provided a variety of historical events that were directly related to landform patterns.

Ultimate Goals for SC MAPS

South Carolina Maps and Aerial Photographic Systems (SC MAPS) has been designed to provide South Carolina students with a background in geological formations, historical development, economic trends, environmental concerns, and current land usage. Ultimately it is hoped that studying details on these maps will lead students to the realization that this state must be protected through wise conservation practices and preserved for our future use and enjoyment.

It is the desire of the authors that through geographic skills enhancement, SC MAPS will help students gain a better understanding of the past, present, and future interrelationships between South Carolina's natural and cultural landscapes. The ultimate goals for SC MAPS are for teachers and students to:

- Perceive the relationships between geological formation and land use;
- Recognize historical and economic reasons for locations of cities, industries, and resorts;
- Identify environmental concerns and economic development trends; and
- Realize that it is the responsibility of all citizens to learn how to use and protect our intriguing landscape.

Stimulating student interest in these topics will be achieved through the use of observable features identified on cartographic products. Enrichment activities, individual and group projects, power thinking problems, and field trip suggestions will aid in arousing students' interest in the state's cultural heritage.

The Legacy of South Carolina Must be Preserved

Taking advantage of technological advances in map products currently available, these curriculum materials have been carefully selected and organized into ten South Carolina study sites with the purpose of students gaining a deeper appreciation for interdisciplinary topics including geology, geography, history, economics, and ecology.

South Carolina Maps and Aerial Photographic Systems (SC MAPS) is an educational package specifically designed to create an awareness among students for the diversity of our state's landforms, natural vegetation, abundant wildlife, recreational facilities, lakes and river systems, and land usage. These make South Carolina an intriguing place to live, a state that, if its resources are wisely used, will be enjoyed for generations to come. We must continue to hand down our legacy to others.

Peggy W. Cain, Ph.D.
South Carolina Department of Education

DESIGN OF SC MAPS

SC MAPS is a set of curriculum activities that have been developed from a diverse collection of aerial photographic, satellite, topographic, and special purpose mapping products available through various sources. The maps were carefully chosen to provide different spatial perspectives through a variety of map scales featuring unique geological features in each of the state's five landform regions.

The initial section of SC MAPS will provide a statewide overview of South Carolina's intriguing resources by examining similarities and differences between landform regions. Five distinct landform regions that make up South Carolina are:

Blue Ridge,
Piedmont,
Sandhills,
Coastal Plain, and
Coastal Zone.

Within each of the landform regions, individual study site have been selected for detailed student activities. Each of the study sites reflect unique geological/geographical features characteristic of a particular region in South Carolina. At least one study site has been selected for each landform region. Furthermore, each of the study sites has been chosen because of its accessibility for student field trips, thereby providing an enrichment activity for further enhancement and appreciation of the study sites.

Each study sites is outlined by the following specific subtopics for ease of use and clarity of understanding.

POWER THINKING: A scenario is introduced at the beginning of each study site, designed to focus on the specific geographical formation and thereby stimulating student awareness of unique features of the area.

RATIONALE: Reasons are outlined for choosing the study site and the importance of the location to the state.

INSTRUCTIONAL OBJECTIVES: Major learning outcomes are stated in behavioral terms.

MATERIALS: Cartographic products needed for the activities are listed.

BACKGROUND INFORMATION: A summary of interesting geological, historical, economic, and developmental trends are provided for each landform region and study site to stimulate student interest, comprehension, and importance of the area.

ACTIVITIES: A variety of instructional strategies are given for directing students through each of the study sites. These activities are divided into Parts A, B, or C depending on the complexity of the study site. Activities may be teacher-directed or self-paced depending on the student's level of attainment.

ENRICHMENT ACTIVITIES: Additional follow-up studies are outlined challenging students to go beyond the cartographic products and focus on the content of the module. These activities require combining applications of newly learned concept and problem solving techniques. The process of analysis and synthesis are applied to both individual and group research projects.

PLACES TO VISIT: Field trip suggestions are outlined for enhancing study site objectives including additional educational programs that may be available.

REFERENCES AND RESOURCES: Further enhancement media, including videotapes and readings taken from books, magazines articles, and booklets currently available, are listed.

CARTOGRAPHIC PRODUCTS

Infrared aerial photographs and their accompanying topographic maps, complemented with special purpose maps, have been selected to focus on a perspective of South Carolina that can be attained in no other way. Ten specific study sites have been carefully chosen to highlight the geological features of South Carolina that have influenced historical development, economic trends, and current land uses. Recent technological gains in photographic and cartographic products are used as a basis to enhance students' geographic skills and create an awareness of the responsibility that citizens must realize in order to protect our natural resources.

State of South Carolina Base Maps

Two **State of South Carolina Base Maps** with identical scales, 1:500,000, have been selected to provide the framework for the study sites. The **State of South Carolina Base Map with Highways** identifies cities, rivers and highways, while the **State of South Carolina Base Map with Shaded Relief** identifies rivers, reservoirs, and cities by variations of color in the landform. Index maps at the beginning of each unit illustrate the location of the study sites selected for SC MAPS and the five landform regions.

High Altitude Aerial Photographs and Satellite Imagery

The activities for each study site focus on information gathered from color infrared high altitude aerial photographs with a scale of 1:58,000 obtained from the **National High Altitude Program (NHAP)**. These photographs were taken of South Carolina by the United States Department of Agriculture with cameras mounted in a Lyre jet flying at 40,000 feet. Another source of the infrared photographs is through the **National Aerial Photographic Program** taken in 1989 of South Carolina from a jet flying at 20,000 feet. The scale of the NAPP infrared photographs is 1:40,000. The **infrared satellite imagery** was recorded by scanning instruments mounted in a satellite orbiting 200 miles above the earth.

The **infrared high-altitude aerial photographs** are unique in the fact that the invisible infrared portion of the electromagnetic spectrum is captured on film. The human eye only sees the visible light spectrum of the electromagnetic wavelengths. This visible spectrum is readily identified when light passes through a prism and we see the colors of the rainbow. The infrared wavelengths fall near the red end of the visible spectrum and are often referred to as "near red." Neither the infrared (near red) nor the ultraviolet band on the other side of the visible light spectrum can be detected by the human eye. Many insects have a broader range of vision and can see wavelengths in the infrared band undetected by the human eye.

The infrared photographs appear reddish and are called false-color maps. **Aerial cameras mounted in jet airplanes using specially designed sensitized film record the infrared wavelengths.** Many details not previously recorded on regular photographs can be depicted on the infrared film such as vegetative patterns, land form features, land usage, water bodies loaded with sediment, and old river beds. The infrared band of light penetrates atmospheric haze better than regular visible light, thereby recording images on hazy days. NHAP and NAPP infrared photographs provide very high quality resolution maps that portray a wealth of information about the landscape.

Interpreting Infrared Photographs

The SC MAPS infrared photographs were taken during the winter months when deciduous trees were in their dormant or "leaf-off" conditions. Interpretation of "false colors" yields information about vegetative ground cover, physical geography, pollution problems, and land use for varying intensity and hues. Leaves of healthy growing vegetation have a high infrared reflectance and are shown as bright red on the photographs. Bright red also indicates winter crops such as rye, wheat, or oats. Evergreen trees such as pine forests appear red. Dormant vegetation such as deciduous hardwood trees of oak, hickory, and gum appear bluish-gray. For this reason, upland pine and river bottom hardwood forests can be easily distinguished. Drainage patterns for an area can be derived by combining knowledge of specific tree habitats with color keys. Fallow fields will appear greenish-white.

Locating and interpreting distinct landform features can easily be identified in these infrared photographs. Granite outcropping, Carolina bays, golf courses, sand ridges, beach overwash, oxbow remnants of meandering rivers, old rice fields, and estuaries all show up very well on these infrared photographs. Sediment loads carried by rivers can also be detected. Infrared wavelengths are totally absorbed by clear water, causing these bodies to appear black and those containing suspended sediments to appear pale blue. Land use features such as roads, buildings, airports, rock quarries, and power line right-of-ways can easily be recognized.

State Base Maps and Topographic Maps

The State of South Carolina Base Maps and topographic maps supplied with SC MAPS were selected from the four standard series of maps produced by the **United States Geological Survey's (USGS) National Mapping Program**. Each map series conforms to established specifications for size, scale, content, and symbols. The series used for **SC MAPS** are the **State Base Maps** with a scale of 1:500,000 and the 7.5 minute **Topographic Maps** with a scale of 1:24,000.

Map scale is the relationship between the distance measured on a map and the corresponding real distance on the ground. The State Base Maps with a scale of 1:500,000 is a ratio using any unit. For example, one inch on the map is equivalent to 500,000 inches on the ground. Meters or kilometers could also be used. The choice of map scale depends on how a particular map will be used and what level of detail or coverage is desired. The state base maps are considered "small scale" which cover large land areas with less detail. Conversely, the 7.5 minute topographic maps are considered "large scale" which shows a greater amount of detail, but cover a smaller land area.

Contour Lines

The shape of the earth's surface as portrayed by contours is the distinctive characteristic of any topographic map. **Contours are imaginary lines which follow the land surface at a constant elevation above sea level.** Contour intervals of selected SC MAPS vary with the relief of the landscape and therefore the location of the maps. Coastal Zone intervals of five feet are common, while the Blue Ridge mountain area USGS maps use 40 feet. Map scale differences are an important concept of SC MAPS, because this provides spatial geographic perspectives of the earth's surface. Both contour intervals and scales are indicated in the legend of each topographic map.

Map Symbols

The USGS maps use standard symbols that are consistent with other maps of that particular series. Likewise, the level of detail for natural and cultural features is the same for the geographic area covered. For example, the detailed study site 7.5 minute topographic maps remain consistent in regards to format and symbols. Refer to the **Topographic Maps** brochure for details of all symbols used for this series of USGS maps. Another important characteristic of the USGS mapping program is the use of colors to distinguish features as well as symbols.

Black	Cultural features such as roads, buildings, and place names
Blue	Hydrographic feature such as lakes, rivers, and swamps
Brown	Contour lines
Green	Forested areas and orchards
Red	Major roads and public lands boundaries
White	Open areas such as agricultural fields and pasture lands
Purple	New features added from aerial photographs during map revision

Standards for USGS Maps

Series & Scale	One Inch Represents Approx.	Land Area	# of Maps Needed for Statewide Coverage
State Base 1:500,000	8 miles	State Area	1
State Base 1:250,000	4 miles	$2^{o} \times 1^{o}$	10
State Base 1:100,000	1.6 miles	$1^{o} \times 30$ min.	28
State Base 1: 24,000	2000 feet	7.5 x 7.5 min.	566

SC MAPS SET

The SC MAPS cartographic products includes one infrared aerial photograph, six transparencies, a number of topographic maps, and several general purpose maps. Each of the ten study sites has been designed to use infrared aerial photographs with accompanying topographic maps. The initial study site will focus on the two State of South Carolina Base Maps. Index maps of South Carolina located at the beginning of each unit indicate the five landform regions and the location of the ten study sites selected for SC MAPS. The two state base maps will be used throughout the activities.

Each detailed study site is comprised of one or two topographic maps and a color infrared photograph or transparency of that area. For the Columbia study site, the infrared high altitude photograph has been mounted for classroom use. Due to the cost of the photographs, six infrared transparencies will be used for the other study sites. Six copies of each topographic map are supplied for student use. In addition, several special purpose maps have been included that illustrate key concepts. The General Soil Map has been included in the map set. Several maps have been inserted into the booklet. The Land/Use Land/Cover Map of this state has been computer generated by the South Carolina Land Resources Commission. Also portions of USGS maps illustrating important concepts have been selected for inclusion in the booklet. The majority of the products have been laminated for protection and use with a non-permanent writing pen. A listing of all standard SC MAPS products is shown in Table I.

Now through recent technological developments, observers on the earth can enjoy the excitement of seeing our planet from a different perspective. These cartographic products are selected and designed to enable students to see South Carolina from an aerial perspective only available from a space ship or airplane and gain an appreciation for the diversity of landform, land use, historical events, and environmental concerns of the state.

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Topographic Maps
US Department of Interior/Geological Survey

TABLE I
LIST OF CARTOGRAPHIC PRODUCTS AND ILLUSTRATIONS

SC MAPS SET

State Base Maps

1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Shaded Relief Map	1:500,000

High Altitude Aerial Photographs

1	NHAP Table Rock Transparency	1: 58,000
1	NAPP Forty Acre Rock Transparency	1: 40,000
1	NHAP Columbia Metropolitan Area Photograph	1: 58,000
1	NAPP Congaree Flood Plain Transparency	1: 40,000
1	NHAP Santee Transparency	1: 58,000
1	NHAP Cathedral Bay Transparency	1: 58,000
1	NHAP Winyah Bay Transparency	1: 58,000

United States Geological Survey Topographic Maps

6	Table Rock, SC USGS	1: 24,000
6	Taxahaw, SC USGS	1: 24,000
6	Columbia North, SC USGS	1: 24,000
6	South West Columbia, SC USGS	1: 24,000
6	Gadsden, SC USGS	1: 24,000
6	Vance, SC USGS	1: 24,000
6	St. Paul, SC USGS	1: 24,000
6	Olar, SC USGS 1: 24,000	
6	North Island, SC USGS	1: 24,000
6	Waverly Mills, SC USGS	1: 24,000

Special Purpose Maps

6	General Soil Map of South Carolina	1: 750,000
1	Land Use/Land Cover by Watershed	

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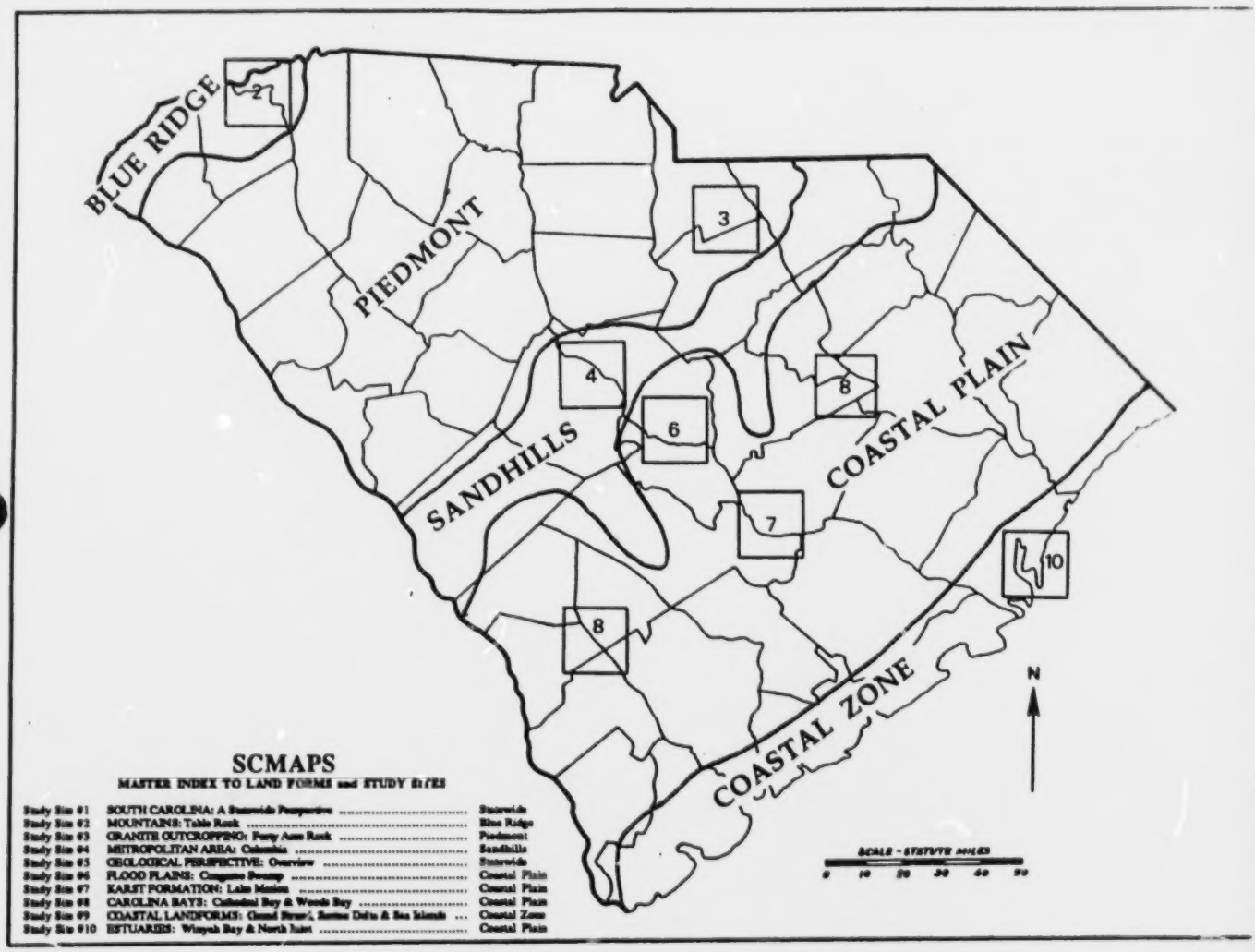
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Study Site #1 SOUTH CAROLINA: A Statewide Perspective

SOUTH CAROLINA'S INTRIGUING LANDSCAPE

STUDY SITE 1

SOUTH CAROLINA: A STATEWIDE PERSPECTIVE

POWER THINKING

You are an explorer in the Carolina Colony in 1730. You want to travel from the coast, the lowest point in the colony, to Sassafras Mountain, the highest point, in what will one day be South Carolina. But your horse hates water! Can you travel from the coast to Sassafras Mountain without crossing water? Find a route that will take you across the least amount of water.

RATIONALE

South Carolina's Intriguing Landscape will introduce the statewide perspective of SC MAPS by unveiling the geological events that formed the five landform regions. In this study site, students will realize how the State's geological features influenced specific movement of early settlers across the state. A closer look at local landforms will lead to an understanding of the larger geological events and processes that have influenced the development of trade, industry, agriculture, and transportation. By using a variety of maps, it is possible to enhance geographic skills while gaining a better perspective of the relationship between drainage patterns, land usage, historical events, and economic development. These studies will encompass present and future environmental concerns.

INSTRUCTIONAL OBJECTIVES

1. Recognize the geological events that shaped the Blue Ridge, Piedmont, Sandhills, Coastal Plain and Coastal Zone landform areas of South Carolina.
2. Relate surface rock exposures to the geologic history of the state.
3. Analyze land use, vegetation patterns, topography, and soils in each of these five regions.
4. Relate transportation patterns and locations of cities to location of rivers and other topographic features.
5. Contrast George Washington's description of our state on his visit through South Carolina as a presidential candidate in 1791 with present day conditions.
6. Examine the state's drainage system and the impact that damming the rivers has had on the cultural and natural landscape.
7. Analyze the relationship of economic resources, manufacturing, industries, and tourism to South Carolina's physical geography.

Note to the Teacher

An overlay has been designed to indicate the five landform regions of South Carolina and ten Study Sites selected for this project. Identical map scales allow the overlay to fit both the State of South Carolina map and the Shaded Relief map.

MATERIALS

1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Base Map, Shaded Relief	1:500,000
1	Land Cover/Land Use Map by Watershed (back cover)	
6	General Soil Map of South Carolina	1:750,000
1	State Map of Rivers, Reservoirs, Bays & Sounds (insert)	Study Site 1-4
1	The Geologic Time Scale and South Carolina (insert)	Study Site 1-6
1	Cross-Section of South Carolina (insert)	Study Site 1-7

BACKGROUND INFORMATION

South Carolina Overview

South Carolina literally stretches from the mountains to the sea and in the process incorporates many distinctive regions, landscapes, cultures, and histories each of which has its own fascinating story to tell. Yet each of these stories is interrelated to the underlying geological formations which provide the framework for current economic and land use. South Carolina is neither a very large nor a very small state. It is not particularly famous nor unusually commonplace among states. In terms of geographic and historical diversity, however, South Carolina definitely qualifies as both extremely interesting and unique. In fact, it is intriguing to residents as well as visitors.

The state can easily be divided into five landform regions:

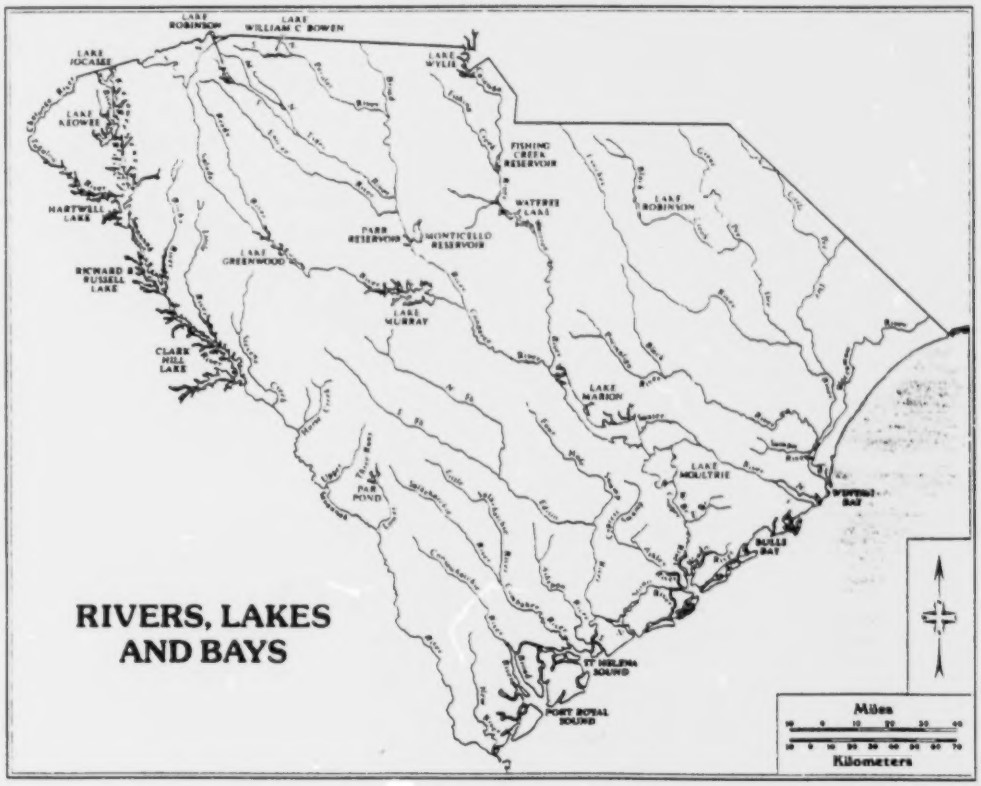
Blue Ridge,
Piedmont,
Sandhills,
Coastal Plain and
Coastal Zone.

These regions essentially run in broad bands parallel to the Atlantic Ocean coastline. Likewise, maps showing the distribution of vegetation or soils project this same banded pattern. Elevations decrease steadily from over 3000 feet in the **Blue Ridge** Mountains to sea level at the coast. Consequently, most rivers run from northwest to southeast. The state is traversed by three major river systems which bring sediment eroded from the Appalachian Mountains through the state to be deposited on the beaches and barrier islands along the coast. The **Savannah, Santee, and Pee Dee River systems** together drain over 80% of the state and are characterized by large quantities of suspended silt and red clay.

All stream sediment is formed originally from the disintegration of solid rock by both chemical and physical weathering processes. Physical processes such as the freezing of water and the growth of plant roots into cracks tend to break rocks into smaller and smaller fragments. Chemical processes such as oxidation and hydrolysis (reactions involving water) alter the original minerals and produce soluble products which are carried off in solution. Runoff from precipitation carries all these products into streams where water currents are then able to transport the material for great distances. The largest sediment sizes are normally found in the mountains where stream energy is the highest. As these grains move downstream, they are progressively rounded, sorted and made smaller until they reach silt or clay size. Larger grains roll or slide along the stream bottom while finer sediment is carried in suspension. The dissolved materials eventually are carried to the ocean where they add to the total salt content of the ocean. In areas of extensive erosion, every rainfall adds even more silt and mud to the stream system. However, streams originating in the **Coastal Plain**, such as the **Edisto and Black River systems**, carry almost no sediment and are stained a dark color by tannic acid derived from the decomposition of organic materials along the river course.

STATE MAP OF RIVERS, RESERVOIRS, BAYS & SOUNDS

USC Dept. of Geography
1987



Of the three largest river systems in South Carolina, only the Pee Dee has remained a free-flowing river throughout the twentieth century. Major dams and reservoirs can be found all along the other systems in all parts of the state. They provide hydroelectric power, municipal water supplies, and opportunities for recreation and tourism development. In addition, these dams increase the loss of water due to evaporation, change local climates, and act as sediment traps which greatly reduce the flow of sand to the coast. As a result, parts of the South Carolina coast are literally starved for sand and are experiencing severe beach erosion.

Geological Events that Shaped South Carolina's Landforms

The primary factor determining landscape in South Carolina is the underlying geology. Rock types and rock structures are responsible for many of the differences we see in the various natural regions. Most of the **Blue Ridge region**, certainly the portion northwest of the Brevard Fault Zone in Oconee County, represented marine deposition of sandstones and shales along the shoreline of a much smaller North American continent during the **Precambrian Eon over 600 million years ago**. The Geologic Time Scale and South Carolina (see insert) compares periods and epochs to South Carolina events. The Piedmont region at 600 million years ago represented a separate landmass, a smaller continental fragment, which had no connection with the North American continent. The **Sand Hills and Coastal Plain** sediments did not even exist then. Roughly **450 millions years ago**, during the **Ordovician Period**, the **Piedmont** landmass collided with the continental margin producing folds, faults, igneous intrusions, and extensive metamorphism, which significantly changed the textures of the original sediments. About **300 million years ago in the Pennsylvanian Period**, the continent of **Africa collided with the Piedmont** producing similar effects only on a much larger scale. Large segments of the Piedmont and Blue Ridge were overthrust onto themselves and the adjacent continent. As a result, most of the rocks in the Piedmont and Blue Ridge are metamorphic. The original sandstones and shales have been converted into gneisses and schists. Iron-rich volcanic and other rocks have been changed to amphibolite, a dark gneiss rich in the mineral amphibole. Igneous intrusions have produced many large areas of granite which are currently mined in several parts of the state. Small deposits of limestone have turned to marble. Most of these rocks are fairly resistant to erosion but the iron-rich schists and amphibolites are more susceptible to chemical weathering and the formation of thick soils and a half rock/half soil substance referred to as saprolite. The red clay common to the Piedmont is a direct result of such chemical weathering, specifically the oxidation of iron minerals.

Following the continental collisions approximately **150 million years ago, during the Jurassic Period**, the supercontinent began to fragment and Africa and North America moved apart from each other as the Atlantic Ocean formed and grew wider. The break was not a clean one, as part of the African crust remained attached to the Piedmont region. This African crust was soon covered over by sediments derived from the mountains to the west. The shoreline during the **Cretaceous Period, about 100 million years ago**, went through the **Sandhills/Midland** of the state and is probably responsible for the sand deposited in what we now call the **fall line zone** or sandhills. Offshore, more marine deposits were laid down over the African crust. These deposits were the beginning of the **Coastal Plain** sediments which are now exposed between Columbia and the coast. As the Blue Ridge Mountains continued to erode, more and more sediment was deposited on the Coastal Plain and the shoreline retreated to the vicinity of its present position. In addition to beach sand deposits, the Coastal Plain also contains shallow-water limestone deposits and shales.

During the retreat of the shoreline to its present position, conditions periodically stabilized during which time shoreline processes built noticeable terraces or escarpments out of **Coastal Plain** sediments. The most noticeable of these is the **Orangeburg Scarp (Citronelle Scarp)** which formed about **25 million years ago in the Oligocene Epoch**. From that point to the present shoreline, **Coastal Plain** sediments are extremely flat and only slightly modified by subsequent erosion. North-westward of that scarp, modern erosion by streams has created a more rolling topography as well as wide floodplains with meander belts and other features of river migration.

THE GEOLOGIC TIME SCALE AND SOUTH CAROLINA

AGE	PERIOD	SOUTH CAROLINA EVENTS
2 m.y.	Quaternary Period-Pleistocene Epoch,	alternating rise and fall of sea level (due to ice age) produces beach ridges on coastal zone
25 m.y.	Tertiary Period-Oligocene Epoch,	Orangeburg Scarp forms, much of Coastal Plain is under water, upstate is undergoing extensive erosion
50 m.y.	Tertiary Period-Eocene Epoch,	Santee Limestone forms in warm, shallow ocean which covers Coastal Plain, upstate is low flat plain
100 m.y.	Cretaceous Period,	over half the state is under water, shoreline at Columbia, sand hills formed, kaolin deposits produced
200 m.y.	Jurassic Period,	Africa and North America begin to split, Atlantic Ocean forms, earliest Coastal Plain sediments are deposited
300 m.y.	Pennsylvanian Period,	Africa collides with North America, forming super-continent, extensive metamorphism, faulting, and igneous intrusions
450 m.y.	Ordovician Period,	Piedmont Region collides with mainland North America causing folding, faulting, igneous intrusions and metamorphism
600 m.y.	Cambrian Period,	Blue Ridge is edge of continent, Piedmont is small separate land mass mostly under water, rest of South Carolina did not exist

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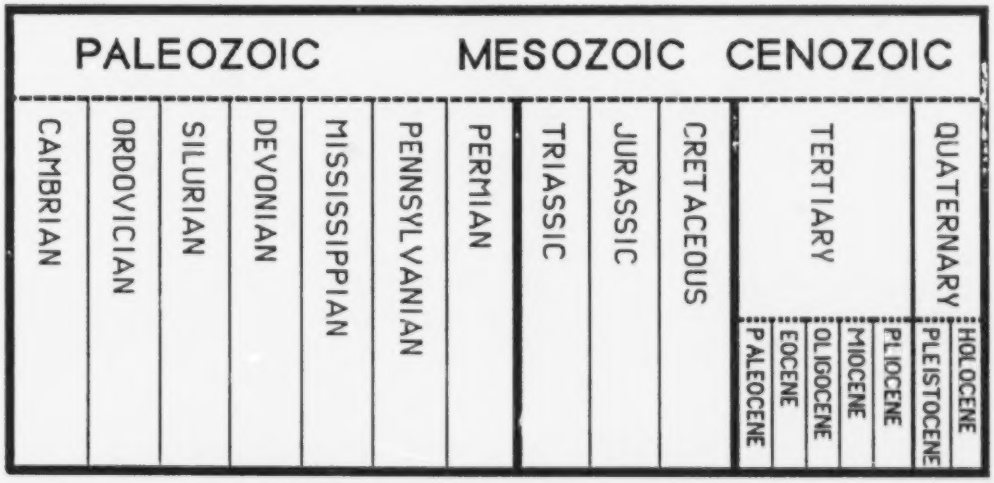
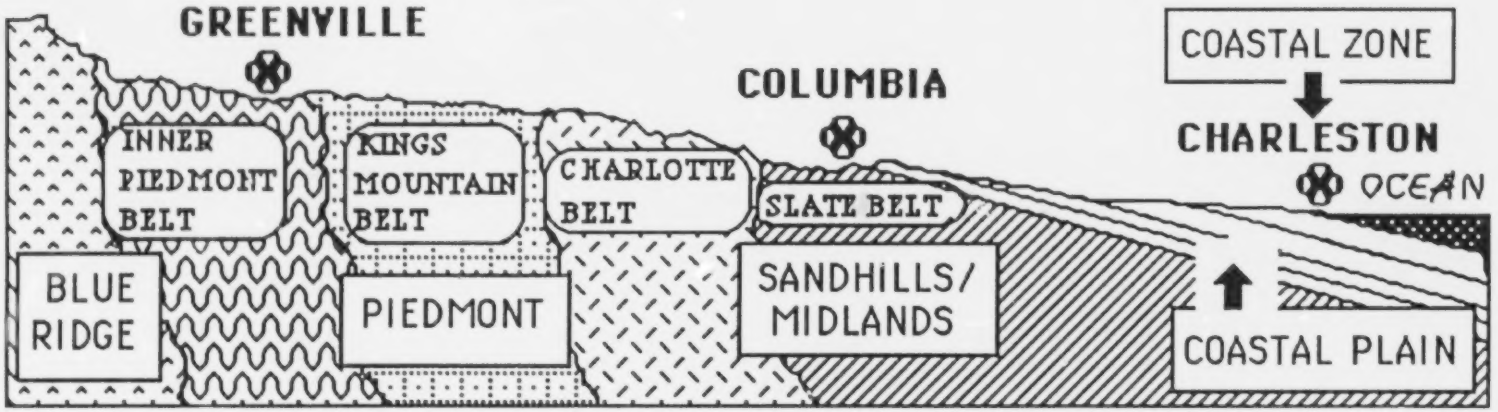


CROSS-SECTION OF SOUTH CAROLINA



BLUE RIDGE = igneous & metamorphic rock

PIEDMONT = igneous & metamorphic rock

- INNER PIEDMONT BELT = severely deformed metamorphic rock
- KINGS MOUNTAIN BELT = less deformed mineralized rock
- CHARLOTTE BELT = metamorphic with many igneous intrusions
- CAROLINA SLATE BELT = slightly metamorphosed mudstones

SANDHILLS/MIDLANDS = sandstone & kaolin, sedimentary rock

COASTAL PLAIN = sandstone, limestone & shale, sedimentary rock

COASTAL ZONE = recent sediments, mostly sand with some mud

The final event to affect the **Coastal Plain** region was the ice age of the **Pleistocene Epoch**. Although the ice did not advance as far south as South Carolina, the alternating advances and retreats of the continental ice mass caused massive fluctuations in sea level which have left many former beach ridges exposed along the **Coastal Zone**. Some of these ridges have been extensive enough to cause the diversion of rivers and tidal inlets. Sharp bends, such as seen along the Black River not far from its mouth, are easily noted on maps and photographs and are probably a result of blocked drainage. Other interesting enigmas, such as the Carolina Bays, which are elongated depressions encircled by sandy ridges, can also be found in the Coastal Plain region.

The geological events shaping South Carolina's land mass were also influencing the topography and structure of the continental shelf off the coast. Erosion, sedimentation, and other physical and biological interactions have resulted in an offshore ocean environment which is increasingly important to the economy of South Carolina. **The Geologic Time Scale of South Carolina** compares events taking place in South Carolina to geologic periods. The **Cross-Section of South Carolina** compares the landform regions to specific underlying belts.

Historical Overview

The pattern of landform regions in South Carolina and the location of its river systems produced natural barriers which confined early transportation across the state to specific trails. Later, these trails became roads and in more recent times highways. In a diary written by George Washington on his presidential campaign visit in 1791, he gave an account of his travels in the period immediately following the American Revolutionary War.

The First Presidential Visit to the Palmetto State

President George Washington entered the state from North Carolina not far from the Myrtle Beach area. He crossed over the **long beach** (Myrtle Beach) to the **swash** and followed the Waggamau (Waccamaw River) to George Town (Georgetown) making a brief stop. From there he traveled down the coast to Charleston where he was met by dignitaries, given a cannon salute, and danced with the ladies at parties. After leaving Charleston, his campaign trail carried him to Savannah and overland through Georgia finally reentering South Carolina in the vicinity of the present city of North Augusta. He traveled by chariot to Columbia along the road that later became a major US Highway. After meeting with state officials in the capital, he continued on his visit through South Carolina. Camden was his next stop where he was again entertained by influential people. From there, he traveled to Lancaster and on back through North Carolina to Philadelphia, which was the Capital of the United States at that time.

The following is an account of George Washington's South Carolina 1791 visit taken from his personal diary and published in **The State** newspaper by W.D. Workman, Jr. in 1980. The original account was printed in a pamphlet prepared by A.S. Salley, a former South Carolina State Historian.

President Washington's South Carolina Visit
Part I

Every four years when the presidential election approaches, South Carolinians expect visits to their state not only by would-be presidents but increasingly of late by the President himself....

The first presidential visit to the Palmetto State, however, was more of a history-making pilgrimage than a vote-seeking political venture. It occurred back in 1791 when President George Washington decided to visit areas of the South where he had never before set foot. He was a Virginian but apparently had never been south of that state, either during the Revolution or in his first term as president.

In April of 1791, Washington set out by horseback from Philadelphia, then the nation's capital, on a trip of more than 1,800 miles over a period of about two months. Fortunately for South Carolinians who savor the historical significance of the President's trip to their state, he kept a diary of his journey.

Crossed the boundary line between No. and South Carolina abt. half after 12 o'clock . . . and lodged at Mr. Vareen's 14 miles more and 2 miles short of the long bay . . .

Mr. Vareen piloted us across the Swash (Wither's Swash) on the long (Myrtle Beach) of the Ocean. Kindly invited by a Doctor Flagg to his house, we lodged there; it being short about 10 miles from Pauley's & 33 from Vareen's.

We left Doctr. Flagg's about 6 o'clock and arrived at Captn. Wm. Alston's on the Waggamau to Breakfast. At Captn. Alston's we were met by General Moultree, Col. Washington & Mr. Rutledge, son of the present Chief Justice of So. Carolina, who had come out that far to escort me to town.

Crossed the Waggamau to Georgetown by descending the River three miles--at this place we were recd. under a Salute of Cannon & by a Company of infantry handsomely uniformed. George Town seems to be in the shade of Charleston--it suffered during the War by the British having had many of its Houses burnt.

Left Georgetown about 6 o'clock and crossing the Santee Creek at the Town and the Santee River 12 miles from it, at Lynch's Island, we breakfasted and dined at Mrs. Horry's and lodged at the Plantation of Mr. Manigold about 19 miles farther.

Breakfasted at the Country seat of Govr. Pinckney & then to the ferry at Haddrel's point, where I was met by the Recorder of the City (Charleston), Gent. Pinckney & Edward Rutledge, Espr. in a 12 oared barge rowed by 12 American Captains of Ships, most elegantly dressed.

As we approached the town a salute with artillery commenced, and at the Wharf I was met by the Governor, the Lt. Governor, the Intendt. of the City, and the two Senators of the State &c, &c.

Was visited about 2 o'clock by a great number of the most respectable ladies of Charleston--the first honor of the kind I ever experienced. Dined with the Members of the Cincinnati and in the evening went to a very elegant dancing Assembly at the Exchange, at which were 256 elegantly dressed & handsome ladies.

Visited the works of Fort Johnson, James Island, and Fort Moultree on Sullivan's Island--both of which are in Ruins. Saturday, May 7th, I visited the Orphan House.

Monday, May 9th, I recommenced my journey for Savanna . . . and proceeded to Col. W. Washington's at Sandy-hill with a select party of particular friends--distant from Charleston 28 miles.

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May 11th. We road 20 miles to a place called Pokitellico where a dinner was provided by the Parishioners of Prince William.

May 12th. By five o'clock we set out from Judge Hayward's, and road to Ruslburg 27 miles to breakfast. At that place I was met by . . . a Comee. from the City of Savanna to conduct me thither.

President Washington's South Carolina Visit
Part II

He reentered the Palmetto State on May 21, at which point we pick up his own description of the trip, as recorded in his personal diary:

Left Augusta about 6 o'clock and takg. leave of the Governor & principal Gentlemen of the place at the bridge over Savanna River, I proceeded in Company with Col. (Wade) Hampton & Taylor & Mr. Lithgow, a committee from Columbia, & a Mr. Jameson from the Village of Granby on my Rout.

May 22. Rode about 21 miles to breakfast, and passing through the village of Granby just below the falls in the Congaree--which was passed in a flat bottomed boat at a Rope Ferry--I lodged at Columbia, the newly adopted Seat of the Government of South Carolina.

The whole road from Augusta to Columbia is a pine barren of the worst sort, being hilly as well as poor. This circumstance, added to the distance, length of the stages, want of water and heat of the day, foundered one of my horses very badly.

Beyond Granby 4 miles I was met by sevl. Gentlemen of that place & Wynnsborough; and on the banks of the River on the No. side by a number of others, who escorted me to Columbia.

Columbia is laid out upon a large scale; but in my opinion had better been placed on the River below the falls. It is now an uncleared wood, with very few houses in it, and those all wooden ones. The State House, which is also of wood, is a large and commodious building, but unfinished . . . near two miles from the River at the confluence of the Broad and Saluda. The river from thence to the Wateree below it takes the name of the Santee and is very crooked; it being, according to the computed distance near 400 miles--Columbia from Charleston is 130 miles.

May 25th. Set out at 4 o'clock for Camden, breakfasted at an indifferent house 22 miles from the town (the first we came to) and reached Camden about two o'clock. The road from Columbia to Camden, excepting a mile or two at each place, goes over the most miserable pine barren I ever saw, showing quite a white sand, very hilly.

May 26th. After viewing the British works about Camden I set out for Charlotte. On my way, two miles from Town, I examined the Ground on wch. Gent. Green and Lord Rawdon had their action. Six miles further on I came to the ground where Genl. Gates & Lord Cornwallis had their Engagement wch. terminated so unfavourably for the former.

Camden is a small place with appearances of some new buildings. It was much injured by the British whilst in their possession. After halting at one Sutton's 4 m. from Camden I lodged at Ingrams 12 miles farther.

May 27th. Left Ingrams about 4 o'clock and breakfasting at one Barr's 18 miles distant lodged at Majr. Crawford's 8 miles farther. About 2 miles from this place I came to the Corner where the No. Carolina lines comes to the Rd., from whence the Road is the boundary for 12 miles more.

As Majr. Crawford's I was met by some of the chiefs of the Catawba nation who seemed to be under apprehension that some attempts were making, or would be made, to deprive them of part of the 48,000 Acres wch. was secured to them by Treaty and wch. is bounded by this Road.

(Barr's, where Washington got breakfast, was a tavern long kept by Nathan Barr just north of the present town of Lancaster. "Majr. Crawford" was Major Robert Crawford whose title has been acquired by much effective service in the militia of South Carolina during the Revolution. Major Crawford's home was Washington's last stop in South Carolina.)

George Washington's diary left an interesting picture of the state's landform regions and transportation as he traveled across the state. In order to have successful plantations, a means of transportation had to be available for produce to get to the market in Charleston. Over the years, transportation in the state has undergone many stages of development including railroads, hard surface "farm to market roads," and highways resulting in today's fine system of interstates. Early transportation within the state followed many of the rivers and streams. In an attempt to take advantage of the natural waterways, a system of canals was proposed. The first attempt was the construction of the Santee Canal in the 1790s. This was followed by an appropriation made by the South Carolina General Assembly.

1819 Internal Improvement Act

During the antebellum period, the South Carolina House of Representatives passed an act providing for a state supported system of internal improvements with the purpose of getting produce to the market in Charleston. In the following passage taken from the 1819 Act, details of the Internal Improvement Act are outlined. One result of this act was the construction of a number of canals. One of the remaining canals is the Columbia Canal on the Broad and Congaree River which is now used for hydroelectric power. Another one is the Langsford Canal which has been partially restored and is maintained as part of the South Carolina State Park System.

A portion of the 1819 Act is reprinted to provide an insight into the problems that the early South Carolinians were facing in getting their produce across various natural barriers to the Charleston port. It is interesting to note that the canal system was never very successful as railroads entered the picture and became a much faster means of transportation.

....And be it further enacted, that from and after the passing of this Act, it shall be the duty of the board of public works, as soon as circumstances will permit, to lay off, open and make, upon the most approved plan, a great road from Charleston to Columbia, and thence along the ridge between Broad and Saluda Rivers, and across the Saluda mountain, to the North Carolina boundary; and also, to devise and adopt all such means as they may deem expedient, to render navigable Great Pedee, as far as the North

Carolina boundary, together with all such tributary streams of the said river, as they may judge expedient–and in like manner to devise and adopt all such means as they may judge expedient, to render navigable Santee, Wateree, Catawba, Broad and Saluda rivers, as well as their tributary streams–and in like manner to proceed, in conjunction with the commissioners appointed by the State of Georgia, to devise and adopt all such means as they deem expedient, to render navigable Savannah river, from Augusta to the confluence of Toogooloo and Keowee, and the Keowee as far as they may deem expedient; and to adopt all such measures as may be necessary to ascertain the practicability of opening a communication by canal or canals between the Savannah and the waters of Broad river, and between the Edisto and the waters of Ashley river–and in like manner to devise and adopt all such means as they shall deem expedient, to render Keowee navigable–and in like manner to proceed in devising and adopting all such means as they may deem expedient, to render navigable, the Waccamaw, Little Pedee, Black River, Edisto, and the tributary streams of the last mentioned river, and both branches thereof–and likewise the Combahee, the Great and Little Saltketcher rivers–and generally, to render navigable such other streams and water courses, and to improve and construct all such cuts, as may facilitate the navigation of the State.

Most of the canals were built to by pass a rocky section of the river. In a number of instances, the rivers did not have enough water for navigation. With the advent of the railroads, the canal system became an unsuccessful venture.

Charleston Business Man's Trip Across South Carolina in 1860

An interesting account of a trip across South Carolina taken by a Charleston Business man in 1860 is reprinted below. Samuel E. Burges, a Charleston business man, describes a variety of transportation modes available to South Carolinians in the mid 1800s. He had to cross a number of creeks and rivers along with diverse landform regions.

Tuesday, February 7, 1860: Rained most of the day and fearing the weather would prevent the steamer leaving [Georgetown] in the morning I tried to get passage on the stage but all the seats were already engaged . . . At night went on board Steamer Charleston to leave in morning.

Wednesday, February 8, 1860: Rained and blew so hard last night that the steamer did not leave, so I went to stage agent and engaged passage, . . . I left on stage at 5 P.M. . . .

Thursday, February 9, 1860: We reached Gourdin's Turn Out a little before 2 A.M. Preferring railroad to stopping here I took the up train to Kingstree, where I spent an hour and took the down train about 4:30 A.M. Reached Charleston at 8 A.M. Stage 42 miles; Northeastern Railroad 78 miles.

Saturday, March 31, 1860: Carpet bag in hand walked [through Charleston] to Charleston and Savannah Railroad where I was just in time to take the boat . . . Crossed Ashley River in the Steamer, found cars waiting, jumped aboard, 2 cars full which delayed our starting, from amount of baggage, until 8:15 A.M. Road in excellent order. Stopped at quite a number of stations, where crowds had assembled to see Steam Horses, or to meet, or part with friends. At Jacksonboro took on Solicitor Perry, by which time we were pretty well thined out. Reached Coosawatchie about 12:20 P.M. Took stage to Gillisonville where I put up with Peterman . . . Charleston and Savannah Railroad 60 miles, stage 5 miles.

Wednesday, August 1860: *Left [Yorkville in buggy] at 7:40 A.M. Took Pinckney road, pretty rough last 5 miles to Broad River which I crossed at Pinckney ferry. Then took Spartanburg road as far as Jonesville following Spartanburg and Union Railroad about 3 miles. Then took off to Glenn Springs [crossed Fair Forest Creek] where I arrived at 7:45 A.M. . . . 43 miles.*

Saturday, September 1, 1860: *Left [Glenn Springs] about 7:40. Took a rough road a piece. Crossed North and South Tyger and Ennoree Rivers. Got into Spartanburg and Greenville road. Reached Greenville about 6:45 P.M. Put up at Goodlett House, where I found several friends. 41 miles.*

Wednesday, September 5, 1860: *Stirred up at 3 A.M. Took Greenville and Columbia Railroad at 4 A.M. Breakfasted at Belton, then took the branch to Anderson, then the Blue Ridge Railroad to Pendleton where I arrived about 8 A.M. Put up at Blue Ridge House [managed] by J.W. Cobb and went about my collections. Greenville and Columbia Railroad 36 miles, Blue Ridge Railroad 14 miles.*

Thursday, September 6, 1860: *Left at 1 P.M. on Blue Ridge Railroad to Anderson. Put up at Benson House [managed] by C.C. Langston . . . Blue Ridge Railroad 14 miles.*

Friday, September 7, 1860: *Finished my business and left on Greenville and Columbia Railroad Branch. At a creek the bridge being down, had to foot it across to another train, which whirled us down to Belton, when after an hour's delay, took main trunk to Williamston . . . Greenville and Columbia Railroad 18 miles.*

The diversity of the state landforms has separated South Carolina into a rather flat topography we refer to as the **Low Country** and rolling hills called the **Up Country.** Historically, this diversity has been marked by differences in the way people have made their living. The **Low Country** is characterized by the City of Charleston as a major trade and shipping center, an aristocratic society with large plantations, and an extensive slave population. On the other hand, the **Up Country** or **Upstate** was settled by frontiersmen, small farmers of Scotch-Irish background, fewer slaves, and less dependence on agriculture with a greater receptability to a manufacturing-based economy. In more recent years tourism is one of the few economic activities that is shared equally by both halves of the state.

SUMMARY

South Carolina has five distinct landform regions: Blue Ridge, Piedmont, Sandhills, Coastal Plain, and Coastal Zone. Each of these regions has unique landscape features, drainage patterns, soils, vegetation, rocks and land use. The diversity of each of the landforms has greatly influenced the development of trade, industry, agriculture, and transportation across South Carolina. All of these distinctive features are economically valuable to the state and all must be used wisely to provide for a secure economic future for South Carolina.

INSTRUCTIONAL STRATEGIES

ACTIVITY A STATE LANDFORM OVERVIEW

Materials

1	South Carolina State Base Map & Overlay	1:500,000
1	South Carolina Shaded Relief Map	1:500,000
1	The Geologic Time Scale and South Carolina (insert)	Study Site 1-6
1	Cross-Section of South Carolina (insert)	Study Site 1-7

Activities

1. Use the state base map with overlay to identify the five major landform regions within the state: Blue Ridge, Piedmont, Sandhills, Coastal Plain, and Coastal Zone. Describe the basic characteristics of each region. In which landform region is your school located?

2. Note that the landform regions form approximately parallel bands. What is the direction of these bands? Note also that these regions are parallel to the present coastline. Consider whether you think this is just a coincidence. Is there a reason why this parallelism should exist? If so, what is it?

3. Identify the age, geological era, and major type of rocks in each region. Why are the rocks in the Blue Ridge and Piedmont mostly metamorphic? Why are the Coastal Plain rocks mostly sedimentary?

4. Using the South Carolina Shaded Relief Map, identify the region that is the most mountainous? Why? Which of the five regions is flattest? Why? Try to locate the Fall Line and the Orangeburg Scarp. Can you identify them easily? Why or why not?

5. Which of the boundaries of the state of South Carolina follow natural geographic features? Explain. Identify the boundaries of your county. Are any of these boundaries natural geographic features?

6. Divide the class into two groups.

   Group I: **Part I of President Washington's South Carolina Visit**
   Trace Washington's travels through South Carolina as outlined in Part I. What were the major towns visited by Washington on this trip? Give examples of his description of the landscape. Identify influential people who he met on his campaign trail. What was the purpose of his journey? What landform regions did he travel through?

   Group II: **Part II of President Washington's South Carolina Visit**
   How did Washington describe the landscape between Augusta and Columbia? Between Columbia and Camden? Describe Columbia and Camden as he saw these towns. Identify the landform region through which he was traveling. How many days was he in South Carolina on this part of his journey? Identify influential people who he met on his campaign trail. What was the purpose of his journey?

7. Choose six of the following cities. Locate them on the map. Suggest a reason as to how each city got its name.

Graniteville	Mountain Rest	Red Bank
Great Falls	Myrtle Beach	Ridgeland
Little Rock	Piedmont	Rock Hill
Mt. Pleasant	Pineville	Ware Shoals

ENRICHMENT ACTIVITIES

1. Write to the Chambers of Commerce of the twelve cities listed. Ask how each town got its name.

2. For more detail of the geologic characteristics of the provinces, use **South Carolina's Land Resources: A Regional Overview** as a source of information. Make a chart identifying the type of rocks for each of the belts and formations. Determine the period, epoch, and formation of the rocks underlying the area where your school is located.

3. Compare George Washington's description of the landscape to that of today. Select two of these people he met and explain their contribution to the early growth of South Carolina.

4. Describe the geologic evolution of the five landform regions and note their differences in regard to surface and sub-surface characteristics such as weathering, tectonics, and erosional processes. Note, in detail, differences in drainage, topography, elevation, soil types, and land usage.

5. Locate a geologic map of the United States and compare landform regions in South Carolina with those of the entire United States. Which southern states have the same regions that are found in South Carolina?

6. Describe the modes of travel that Samuel E. Burges used as he traveled through South Carolina in 1860. Following the same route, which means of travel could you use today?

ACTIVITY B **STATE DRAINAGE PATTERNS**

Materials

1	State of South Carolina Base Map	1:500,000
1	State of South Carolina Shaded Relief Map	1:500,000
1	State Map of Rivers, Reservoirs, Bays & Sounds (insert)	Study Site 1-4
1	Package Tracing Paper	

Activities

1. Using either the State of South Carolina Base with Highways or the Shaded Relief, as a class, trace and outline the drainage basins for the following river systems: the Savannah, Santee, or Pee Dee. Identify significant landmarks.

2. Some areas of the state are not drained by the three major river systems. Locate on the map the two smaller systems, the Edisto and Black Rivers. Which landform regions do these smaller rivers drain?

3. Imagine yourself in a "little boat" and you wanted to get to the ocean. Follow the path of water as it drains your school yard all the way to the Atlantic Ocean. Name each stream, river, lake/dam that you must follow as the water flows to the ocean.

4. Work on the following problems, using student groups. Use class discussion as a follow up.

   Group I: If chemical pollution were introduced into the Pacolet River in Spartanburg, which major South Carolina cities would be concerned about it affecting their water supply? How many people would this affect? What type of wildlife would be affected? Would there be an impact on tourism and recreational facilities.

   Group II: If toxic waste materials were to enter the head waters of Lake Marion in the vicinity of Pinewood and Remini, which areas would be affected by contaminated water? Should the people living down stream be concerned? Which towns and cities would suffer the most? What type of fish and wildlife would be disturbed in each area? Which industries should voice a concern? Would this have an impact of tourism and recreational facilities in the area?

5. Which river systems can be expected to produce deltas where they empty into the ocean? Why? Locate the Santee-Cooper diversion canal. What impact does it have on the Cooper River? What impact does it have on the Santee River? What effect do the dams have on the continuing development of the Santee Delta? Analyze the impacts on the Santee River basin of the diversion and re-diversion canal projects.

6. Working in groups, locate and name five large man-made reservoirs in South Carolina. Make a list of all the recreational and industrial uses of these reservoirs. Identify the positive and negative impacts of creating these reservoirs. Compare your impacts with the other group.

7. What was primary mode of travel used by President Washington in Part I of his South Carolina visit? Identify the bays, sounds, ports, and rivers that he saw on this visit? How many days was he in South Carolina on this part of his journey?

8. In Part II of Washington's visit, how did he cross the Congaree River? What were the other major rivers that he crossed? Compare crossing these rivers today with that of the late 1700s?

ENRICHMENT ACTIVITIES

1. Large industries, plants, and businesses in this state depend on our river systems and reservoirs for water in a variety of ways. Each one represents a different type of use. Explain how water is used and whether or not it is returned to the river or reservoir. What are the possible pollutants from each use listed below.

    a. Hydro-electric generating plant near Columbia on the Saluda River.
    b. Coal fired generating plant in Conway on the Waccamaw River.
    c. Paper mill in Georgetown on the Sampit River.
    d. Textile plant in Greenville on the Reedy River.
    e. Soybean farm in Orangeburg County on the Edisto river.
    f. Nuclear processing plant in Aiken on the Savannah River.

2. South Carolina has a Scenic River Act identifying picturesque rivers. Research this act to see how a river can be added to this list. Write a paper comparing the rivers and tributaries in the Blue Ridge mountains and Piedmont with those of the Sandhills and Coastal Plain regions. Include in this comparison the sediment load, salinity, and acidity of the water. What is meant by "water is constantly rearranging the landscape?"

3. Monitor the dissolved oxygen, acidity, and/or heavy metal contaminants over several months in the stream, river, or lake nearest your school. To facilitate this activity, water testing kits can be purchased at feed and seed stores or through scientific supply companies. Research how toxic or hazardous waste materials pollute our river systems. What happens when too much sewage is allowed to enter a stream? What effect do phosphates and nitrates have on the growth of algae? What is eutrophication?

4. As Coastal Plain rivers meander their way to the Atlantic Ocean, they eventually are influenced by the tidal action of the salty Atlantic. What differences in plant and animal life would you expect to find along the immediate coast compared with the rivers 50 miles inland? Make a listing of limiting factors such as temperature and salinity that plants and animals must cope with for each environment.

5. Locate five major sounds and bays that are formed as rivers flow together and meet at the Atlantic Ocean. How do these areas contribute to wildlife habitat, seafood industry, and recreation?

6. The wood duck is a colorful native bird inhabiting the wooded swamps and rivers of South Carolina. The habitat required for wood ducks is decreasing due to logging activities, creation of open water reservoirs, and conversion of forested wetlands to agriculture. Research the habitat requirements for the wood ducks including food, nesting habits, and predators. Make recommendations for the steps needed to protect the habitat. Have these recommendations printed in your school or local newspaper. Note that Ducks Unlimited, South Carolina Water Fowl Association, and South Carolina Wildlife and Marine Resources Department all have programs protecting and enhancing native wood duck populations.

ACTIVITY C **LAND USE OVERVIEW**

Materials

1	State of South Carolina Base Map	1:500,000
1	State of South Carolina Shaded Relief Map	1:500,000
1	Land Use/Land Cover Map by Watershed (back cover)	
6	General Soil Map of South Carolina	1:750,000

Activities

A suggested teaching strategy is to divide the class into six groups. Organize six stations, one for each activity. Provide maps, resources, and a table for each station. Have the students rotate through three of the stations allowing enough time to complete the activity. On the next day have the students report their findings to the class.

1. Name the city with the largest population in each of the five regions. Why is each city located where it is? Give a unique characteristic of each city. Nicknames are often given to cities. For example, one is called the "Port City" another one is identified as the "Textile City," or "Capitol City." Suggest nicknames for the other major cities in South Carolina. Give a unique characteristic of each city. Does the city nearest your school have a nickname? If so, what is it?

2. Compare the Land Use/Land Cover Map and the General Soil Map of South Carolina. Use as a reference "South Carolina's Land Resources: A Regional Overview," pages 17-25). What are the soil and land resource divisions? How does the land use compare to the major soil groups? Name a major land use or industry found in each of the divisions that depends on natural resources such as forests, soils, and estuaries. Do these land uses follow geological and landform patterns? Explain.

3. Describe the geological events that have shaped each of South Carolina's five landforms. How do these geologic landforms differ? How are they alike? Use the "Geologic Time Scale of South Carolina" and the "Cross-Section of South Carolina" to compare the landform regions to specific underlain geologic belts. How are the Blue Ridge mountains used? Why do you think there is a concentration of industries in the upper part of the state? Where are the major farm lands found? What factors have contributed to the present use of South Carolina's coastal area.

4. What was the major method of transporting goods in the 1700s? Using Washington's diary, what were the major cities in South Carolina at that time? What was the major method of transporting goods in the 1800s? Between which pair of cities listed below would transportation have been most difficult around 1800? Explain why.

   - Beaufort and Georgetown
   - Columbia and Greenville
   - Greenville and Cheraw
   - Columbia and Charleston

5. Using present day US highway numbers, follow Washington's visit Part II as he reentered South Carolina from Georgia and traveled from North Augusta to Lancaster. Compare his trip in 1791 to our present day mode of travel. What route would he have taken today traveling on US Highways? Interstates? How long did it take him to travel from North Augusta to Lancaster? About how many miles did he travel each day?

6. Outline all of the modes of transportation that were used by the "Charleston Business Man's Trip Across South Carolina in 1860." Contrast this to today's modes of travel across South Carolina. How do you think he would make this trip today?

ENRICHMENT ACTIVITIES

1. Locate the large metropolitan cities in South Carolina. What has attracted people to these areas? Identify the National Forests and National Wildlife Refuge areas on the State Base Map. What features have caused these particular locations to be selected as national parks? What benefits do these parks and refuges give to man?

2. Using reference materials, write a brief essay on what you think life in South Carolina was like when Washington toured the state. Include the culture, foods eaten, clothes worn, government, and entertainment. Compare the life of a farm laborer to that of the plantation owner.

3. Explain why cities like Charleston, Greenville, Spartanburg, Columbia, and Florence have continued to grow as trade centers while many small towns in South Carolina have declined in the state's economy.

4. Which Indian nation voiced a concern to Washington that part of its land might be taken away? Find out how much land the Indian nation possessed? Where was this land located?

5. Research three land use management programs in South Carolina.

    - Forestry Management and Wildlife
    - Agricultural Soil and Water Conservation
    - Water Conservation and Management

6. Under the Weeks Act of 1911, the United States Government acquired vast acres of land that have been logged bare by the owners. One of the primary purposes was to establish National Forests. Since that time forest management practices have established prime timber. Many people think it is time to harvest this timber. Environmentalists want the trees left alone. Discuss the pros and cons of harvesting vast amounts of forest lands. How do you think timbering affects the bears? How do you think clear-cutting affects the turkeys, raccoons, deer and squirrels?

PLACES TO VISIT

- Man-made lakes both large and small are located over most of South Carolina. Plan to visit the one nearest your school. Identify the sources of water, type of dam, and means of flood control. How is this lake used?

- Many farms, factories, and businesses located near your school depend directly on land resources. Plan a visit to one of these places to determine which resources are used and how disposal of waste products is accomplished.

- Ask a geologist in your area, perhaps at a nearby college/university, to lead a field trip explaining the geology of your area.

- Visit a farm which practices forest and wildlife management or uses soil and water conservation practices. To make arrangements for a visit to a farm or forest contact your local Soil and Water Conservation District Office. The phone number is in your local telephone directory.

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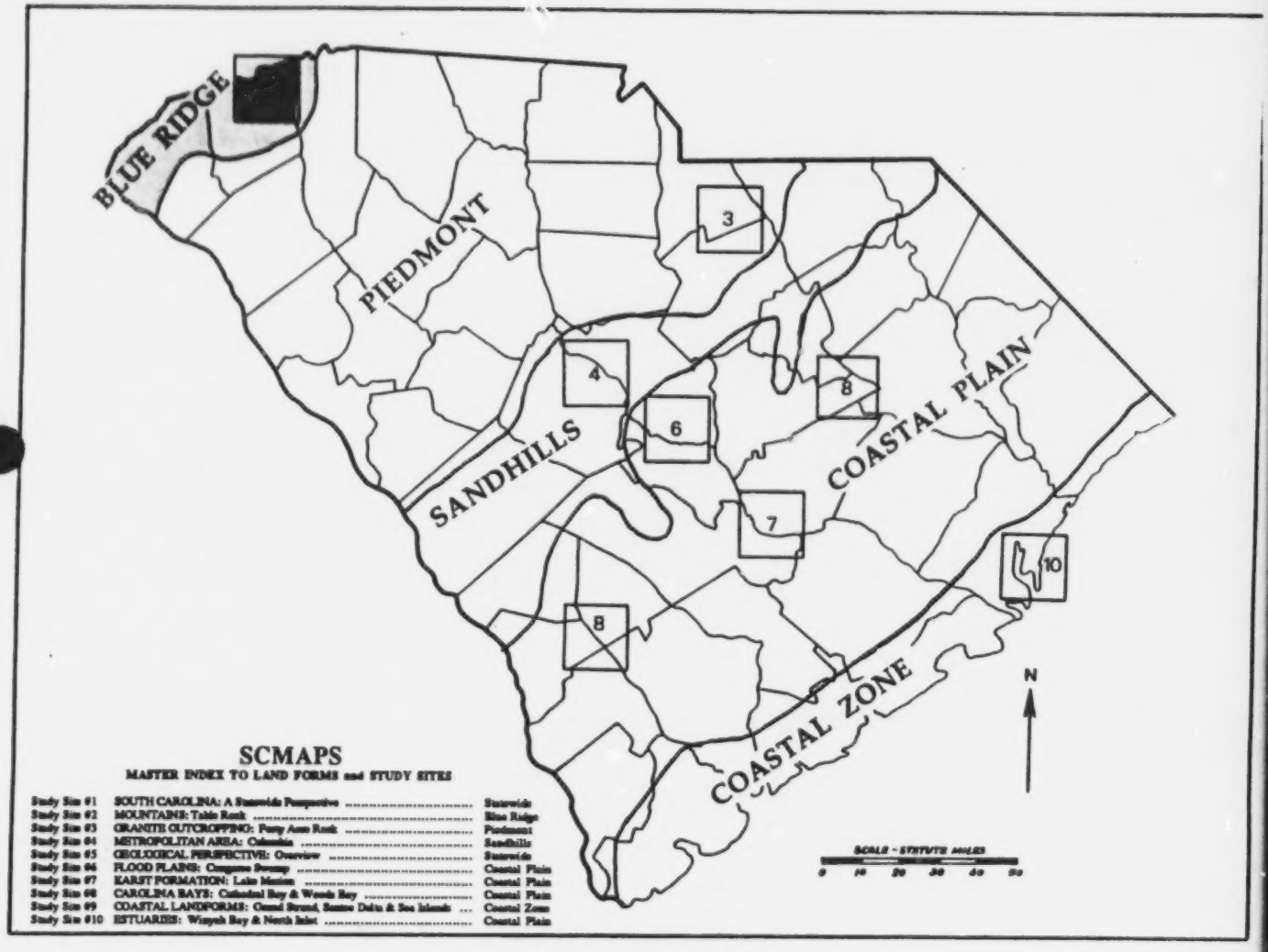
BLUE RIDGE
PIEDMONT
SANDHILLS
COASTAL PLAIN
COASTAL ZONE
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SCMAPS
MASTER INDEX TO LAND FORMS and STUDY SITES
Study Site #1 SOUTH CAROLINA: A Statewide Perspective ..... Statewide
Study Site #2 MOUNTAINS: Table Rock ..... Blue Ridge
Study Site #3 GRANITE OUTCROPPING: Pretty Anne Rock ..... Piedmont
Study Site #4 METROPOLITAN AREA: Columbia ..... Sandhills
Study Site #5 GEOLOGICAL PERSPECTIVE: Overview ..... Statewide
Study Site #6 FLOOD PLAINS: Congaree Swamp ..... Coastal Plain
Study Site #7 KARST FORMATION: Lake Marion ..... Coastal Plain
Study Site #8 CAROLINA BAYS: Cathedral Bay & Woods Bay ..... Coastal Plain
Study Site #9 COASTAL LANDFORMS: Grand Strand, Santee Delta & Sea Islands ... Coastal Zone
Study Site #10 ESTUARIES: Winyah Bay & North Inlet ..... Coastal Plain

Study Site #2 MOUNTAINS: Table Rock

BLUE RIDGE

STUDY SITE 2

MOUNTAINS: TABLE ROCK

POWER THINKING

You are an aircraft controller in the Greenville-Spartanburg control tower, and you receive the following radio call "MAYDAY MAYDAY MAYDAY this is SC320, I have just experienced an engine failure and am losing altitude . . . heading due South . . . passing over a ridge oriented West North West to East South East . . . turning left to avoid a tall cliff . . . flying down a small creek . . . altitude now 2,000 MSL." Use this information and the Table Rock, USGS Topographic Map to locate the pilot. Trace the probable path taken by the pilot on the topographic map. Locate, by giving latitude and longitude, the most probable area in which to conduct the search.

RATIONALE

The Blue Ridge Landform Region comprises the far western border of South Carolina, touching only three counties, yet produces some of the most spectacular scenery in the state. This mountainous region, known for white water rafting, waterfalls, and wilderness forests, includes several unique natural preserves. It has recently become a major tourist attraction not only for our state but for the entire Southeastern USA region. Table Rock State Park is one of the best known parks in the state and will serve as our representative of the Blue Ridge region. Studies of topographic maps, aerial infrared photographs, and satellite infrared photography illustrate both the area's unique natural features and the increasing effect of human encroachment on the region both by extensive logging activity and by recent development of recreational and retirement communities. Ultimately, such development may damage the recreational and scenic values of the area unless steps are taken to protect and preserve the natural beauty which the tourists come to enjoy.

INSTRUCTIONAL OBJECTIVES

1. Contrast landform features of the Blue Ridge with other regions.
2. Recognize major rock types that make up the Blue Ridge landforms.
3. Recognize the importance of unique habitats which provide conditions necessary for many species of rare plants to thrive.
4. Understand why mountain coves are unique features that deserve protection.
5. Outline the possible threats to the present Blue Ridge environment of South Carolina.
6. Identify the reasons for the location of farms and housing developments.
7. Locate Indian trails (and later highways) that follow certain specific routes through the area.

MATERIALS

1	NHAP Transparency Table Rock	1: 58,000
6	Table Rock, SC USGS Topographic Maps	1: 24,000
1	Package Tracing Paper	

BACKGROUND INFORMATION

The Blue Ridge and Piedmont Landform Boundary

The boundary between the Piedmont and Blue Ridge landform regions is marked by sharp changes in elevation and slope. The higher elevation Blue Ridge shows considerable relief as indicated by huge cliffs, large waterfalls, and deeply eroded valleys. The contrast with the relatively flat Piedmont has long baffled geologists because the rock types of the two regions are fairly similar. Some have tried to relate this difference to a major vertical fault but no direct evidence of uplift has ever been found. Another theory proposes that over 70 million years ago the Atlantic Ocean extended westward to this area and extensive shoreline erosion affected the Piedmont but not the Blue Ridge. Again, no direct evidence of such an event has ever been found. A final attempt to explain the sharp transition is the difference in stream power between streams flowing to the north from the Blue Ridge and streams flowing to the south. Stream flow northward from the Eastern Continental Divide has a much lower gradient (slope) and therefore erodes much more slowly. Southward flowing streams have much higher gradients and erode deeply into the landscape. Such stream behavior could allow the Blue Ridge boundary to be maintained through time even while the divide itself migrated slowly northwestward.

Blue Ridge Rock Types

Blue Ridge rocks are composed of various types of igneous and metamorphic rock and in the Table Rock area granite-gneiss and amphibolite predominate. Amphibolite is a very dark banded gneiss with high concentrations of the mineral amphibole. The mass of rock we know as Table Rock Mountain started out deep underground as a large igneous intrusion of granite called a batholith. During several episodes of tectonic activity, due to continental collisions, that rock was uplifted and metamorphosed. During this metamorphism, minerals were totally recrystallized by high temperatures and pressures to create a texture very different from that found in the original rock.

As erosion removed the overlying rock and soil, the granite-gneiss rose closer to the surface and began to expand and crack because of the lower confining pressures near the surface of the earth. Eventually, the resistant granite-gneiss rose so high that all surrounding rock was eroded away and the mountain as we know it today took form. Because of the cracking and expansion, sections of the rock often slide off of the steep slope to crash to the ground at the base of the exposed cliffs. It is this frequent sliding of rock, along with the dense crystalline nature of the rock, which prevents trees and other vegetation from populating the exposed rock slopes of Table Rock Mountain as well as several other similar mountains in the Blue Ridge and upper Piedmont regions.

In addition to being altered by metamorphism, the rock in the Blue Ridge region has been severely fractured and folded. The fractures in particular create zones of weakness and provide preferred pathways for stream erosion and chemical weathering. Sudden bends in the generally rectangular drainage pattern, as seen on maps and photos, mark the intersections of such fracture lines. The cliffs of Table Rock itself are roughly parallel to existing fracture lines. Folds in the rock are not noticeable on maps or aerial photographs, but are easily seen while walking along the many trails within the park.

In general, the higher elevated section of Table Rock Mountain is mostly granite-gneiss and is very resistant to erosion. The lower elevations generally are underlain by the less resistant amphibolite. The relative positioning of these two main rock types, resistant and non-resistant, determines the occurrence of

waterfalls, rapids, and water slides within the area. Vegetation grows much more readily on the more easily decomposed amphibolite areas.

The reputation of the Table Rock area as a tourist attraction mostly reflects the dramatic slopes and high relief of the area. This effect is mostly due to the different resistances of the major rock layers and the widespread erosion of powerful streams especially during storms. These elevation differences are sufficient to produce spectacular scenery and also unique microclimates and microenvironments found nowhere else in South Carolina. Not far from Table Rock State Park are features such as Whitewater Falls, white water rafting expeditions on the Chattooga River, the Walhalla Fish Hatchery, Caesar's Head Mountain and several Heritage Preserves such as the Ashmore Tract and Watson Bog.

Heritage Preserves

Within the Blue Ridge region are located many small but important pockets of land with unique environmental characteristics which harbor many species of rare and unusual plants and likewise provide specialized habitat for animals. Mountain coves which face south are often protected from storms and enjoy a much milder and more humid climate than the surrounding regions. Bogs and water slides also create unique conditions where rare plants flourish. An example of such a plant is the insect-eating mountain sweet pitcher plant which is found only in the Carolina mountains. These special areas are fragile and can easily be destroyed by development activities. The Heritage Trust Foundation with the assistance of the South Carolina Nature Conservancy has purchased several of these sites to protect and preserve them for years to come.

Table Rock Legend

How was Table Rock named? Many legends have been told about this unique geological feature. Reece, in his history of Pumpkintown, relates this tale.

> *In the days of extreme witchcraft, the witches had planned a convention and needed a place to meet. They chose the flat top of our mountain. The morning session had ended and it was time for lunch, but they had no table on which to spread their lunch. They bewitched the wind and commanded it to blow the rock clean. The wind blew--and it blew and blew until there was nothing left on the rock. So, they spread their lunch on it. But, there were no chairs and they knew their mighty Wizard, The Old Man of the Mountain, must be provided a place to sit. So the witches made ready the little hill into a stool for their ruler. He sat on this stool and ate from the table of rock. So, this welded the name Table Rock to the mountain and The Stool to the nearby hill, and the wind is still keeping the rock clean.*

On the lower part of Table Rock cove was the junction point of the **State Road** which ran from Charleston into North Carolina and the Keowee Trail (or Cherokee Path) to Virginia. This junction point was given the name Pumpkintown because of the large and plentiful pumpkins that the early settlers grew. Even in the days of the colonists, the Table Rock area was used as a recreational haven. In 1840, Table Rock Hotel was built. It was a two-story building constructed from lumber sawed on a Pumpkintown farm. Between Table Rock and Stool Mountain on a flat area a **saddle** or **horse-rack** was built to serve the travelers who came by horse. Table Rock as a resort site experienced periods of plenty followed by years of lean. During the 1930s, under Franklin D. Roosevelt's administration, the area surrounding Table Rock was purchased by the state of South Carolina for a park. The Civilian Conservation Corp (CCC), organized as part of Roosevelt's New Deal, provided work for young men during the depression. The CCC boys landscaped the area and built a fresh water lake on the grounds. Today many nature trails, instructional programs, swimming, boating, birding and other recreational activities are available and enjoyed by vacationers.

Recent Trends

Much of the Blue Ridge region remains relatively untouched by modern civilization. Until recently, only Cherokee Indian villages and log cabins of early settlers were found in this region. More and more, however, two dangers threaten the integrity of this scenic natural area. Logging has been commercially important to the economy of upper South Carolina for some time, but only recently has the practice of clear-cutting become widespread. So long as only selected trees are harvested, and the view from Table Rock and other mountain overlooks remains scenic, the public will not be upset. Tourists do not respond favorably to views of bare mountain slopes and exposed logging roads. The greatest threat to this region is over development and over commercialization. Power projects have drastically changed the landscape by forming lakes from dammed rivers and streams. Housing developments for retirement communities and recreational developments have steadily encroached upon wilderness areas. The values which have made the tourist industry so successful are themselves endangered by that success. The landscape is not static. It is and will continue to be affected by the activities of people.

SUMMARY

At some point the conflict between commercial exploitation and tourist and wilderness values must reach an acceptable compromise. Should the Blue Ridge of South Carolina lose its wilderness character and its scenic beauty, tourist benefits will be severely diminished and a valuable state economic resource will be lost along with many unique species of plants and animals which depend on that wilderness environment for their existence.

INSTRUCTIONAL STRATEGIES

ACTIVITY A BLUE RIDGE LANDFORM PATTERNS

Materials

1	NHAP Transparency Table Rock	1: 58,000
6	Table Rock, SC USGS Topographic Maps	1: 24,000

Activities

1. Locate Table Rock and Stool Mountains on the infrared transparency. Compare these features on the transparency with the Table Rock topographic map. Locate Caesar's Head Mountain. Using the topographic map, what is the elevation of these mountains? Locate the latitude and longitude of the highest elevation point on the map. Locate Pumpkintown and the Oolenoy, Saluda, and Keowee River valleys. Using the scale bar on the map, how far is Pumpkintown from Table Rock?

2. Trace all stream courses north and west of Table Rock Mountain on the topographic map. Examine your tracing and describe the pattern of drainage in this area. What might cause such a pattern? Examine the cliff exposures on Table Rock and nearby mountains. Add to your tracing paper, cliff lines in a different color. How does the cliff pattern compare with the stream pattern? Would you have expected this result? Why?

3. Examine the streams on the topographic map comparing the patterns and land elevations. Identify two areas where a waterfall is likely to be found. Why did you choose these areas?

4. Examine the vegetation patterns on the infrared transparency. What factor is most responsible for the different colors along streams versus mountain tops. Recall that the infrared aerial transparency was taken during the month of April. How would the vegetation pattern be different in July? In December?

5. Several lakes are visible on the transparency. Notice that most of the lakes in the upper half of the transparency are a slightly different color than the lakes in the lower half. What do you think causes this color difference? Why is there such a clear separation on the photo of the two groups of lakes? Relate this to the division between the Blue Ridge and Piedmont regions.

6. Using the transparency and the topographic map, locate a south-facing cove or hollow in the mountains. Explain why such areas are wetter, warmer, and more protected than surrounding areas.

7. On the topographic map, locate the North Carolina-South Carolina boundary line. In which direction do the North Carolina rivers flow? In which direction do the South Carolina rivers flow? Which direction is the South Saluda River flowing? Why is a drainage divide the sensible place to locate a state boundary line?

8. Can you locate the North Carolina-South Carolina state line on the infrared transparency? If so, how? If not, why not?

ENRICHMENT ACTIVITIES

1. Plan a publicity campaign to alert other students to the unique mountain cove environments and the Heritage Trust areas. Outline all the reasons for preserving and protecting these unique areas.

2. White-tailed deer, black bears, silver and red foxes, and gray squirrels are all inhabitants of South Carolina's mountain forests. Divide the class into groups and have them select one of these mammals to research. Habitat, food, range, reproduction can be included in their life history research. What is needed for each of these animals to survive in the face of continuing development?

ACTIVITY B **MEASURING TOPOGRAPHY**

Materials

1	NHAP Transparency Table Rock	1 :58,000
6	Table Rock, SC, USGS Topographic Map	1: 24,000
1	Package Tracing Paper	

Activities

1. Make a profile across Table Rock State Park using the topographic map. Draw a section line starting at the peak of Pinnacle Mountain at the western edge of Table Rock Mountain, and ending in the Table Rock Reservoir just to the right of the final letter "r" in the word "reservoir." Using this line as the section line, construct a topographic profile with a vertical scale of 1 millimeter = 40 ft. If constructed carefully, the profile will show the way the skyline should appear as viewed by a person riding in a car along State Highway 11 (the Cherokee Foothills Scenic Parkway). What is the highest elevation at the peak of Pinnacle Mountain? What is the highest elevation at the peak of Table Rock Mountain? What is the water level elevation in Table Rock Reservoir? Calculate the local relief between Table Rock Mountain and Table Rock Reservoir.

2. On the Table Rock Topographic Map, two landform regions can be identified, the Blue Ridge Province and Piedmont. Locate the approximate boundary between the two regions on the topographic map. Look carefully at contour lines. At what elevation does this transition occur?

3. Now, make a profile of the area around State Highway 11. Draw a second line starting at the letter "y" of the word "Oolenoy River" in the lower left hand corner of the topographic map and ending at the symbol labeled "New Town School" located in the lower middle part of the map. Using another sheet of paper, construct a second topographic profile using the same vertical scale. This profile will show the way the skyline should appear to a person looking southward from Highway #11. What and where is the highest elevation anywhere on this profile? The lowest elevation? Calculate the total relief between the highest and lowest points along this profile. What is the approximate elevation of the New Town School Building?

4. Contrast the scenery you would see driving along State Highway 11 on both sides of the road. Describe each side.

ENRICHMENT ACTIVITY

1. Using the NHAP transparency, calculate the total relief of Table Rock Mountain by measuring the length of the shadow cast by the mountain. You can do this because we know the sun is approximately 5 degrees north of the celestial equator in April when this infrared aerial photograph was taken and Table Rock Mountain lies at approximately 35 degrees north latitude. This means that the sun would appear to be 60 degrees above the horizon at midday. Elementary trigonometry gives the following relationship:

Local Relief = Tangent 60^{o} X Length of shadow (in feet)

ACTIVITY C LAND USE AND DEVELOPMENT

Materials

1	NHAP Transparency Table Rock	1: 58,000
6	Table Rock, SC USGS Topographic Maps	1: 24,000

Activities

1. Look carefully at the infrared transparency. Identify farm fields, small towns or communities, logging roads and developed versus undeveloped land. What type of landform, slope, and topography is associated with each type of land use? Refer to the topographic map to see how well you were able to identify the above features.

2. Look at the pattern of agricultural fields in the lower half of the infrared transparency. Why are these fields located where they are? Along what landscape features are they associated?

3. Mountainous areas always pose transportation problems. Early Indian trail blazers looked for passes through the mountains which provided the lowest possible slope. Modern highways in general follow original Indian trails. Keeping in mind the landforms of this region, plot the best trail route from Table Rock Reservoir to the East Fork Road in North Carolina, found near the upper left hand corner of the topographic map. Is your route a straight line? Why or why not? Compare your route with others in your class. Which route is best? Why? Use the given map scale to calculate how long the trail will actually be versus how long the distance is "as the crow flies."

4. The city of Greenville uses Table Rock Reservoir on the Saluda River as its drinking water supply. Why do you suppose the city fathers of Greenville built a dam on the Saluda River over 25 miles away from the city, when they could have built a reservoir on the same Saluda River just a few miles west of the Greenville City limits?

5. Why was Pumpkintown a logical place for a junction point for early travelers? Explain the destination of the travelers on these well traveled roads. Is this located on a main highway now?

6. On the topographic map, notice the features in purple. These represent new developments or other changes which have occurred since 1946 when the land was surveyed for the original map. What section of the map area has experienced the most change? How will these changes affect the environment and the scenic features of the Table Rock area?

ENRICHMENT ACTIVITIES

1. Talk with a local realtor about where and why new developments are planned in the Blue Ridge region.

2. Talk with a timber company representative. Find out what trees are being harvested in the Blue Ridge region and why. List the pros and cons of clear cutting.

3. Examine state and local programs designed to protect scenic mountain areas. What types of land use controls are needed such as zoning and building restrictions?

4. As growth and development occurs in the mountains, erosion and sedimentation (deposition) increases. Along with this, the need for wastewater disposal and drinking water increases.

How might these trends affect the trout fishery in mountain rivers and streams? Research the life history of the rainbow trout or brown trout.

PLACES TO VISIT

- Schedule a wildflower tour in the Blue Ridge or Upper Piedmont Region. Take wildflower identification books along. Be sure to compare habitat locations, exposure to the sun, and drainage of the soil for at least five different wildflowers.

- Visit a cove. List all of the distinctive vegetative materials, habitat, presence of organic material, moisture in the soil, temperature range, and general characteristics of the soil such as sandy, clayey, or loamy.

- Visit Table Rock State Park which has a variety of special events scheduled during the year. Workshops, nature walks, and inservice programs can be planned for student groups by calling 878-9813 or 878-6641.

- Plan a field trip to interesting natural areas like Whitewater Falls or a white water and scenic river such as the Chattooga.

- Walhalla Fish Hatchery provides an excellent tour and explanation of how fresh water trout are grown and released into the mountain streams, which are their natural habitat.

- Caesar's Head State Park is another excellent example of a scenic mountain area composed of granite-gneiss. The park offers several trails and planned programs. Visits can be scheduled by calling 836-6115 or 836-7438.

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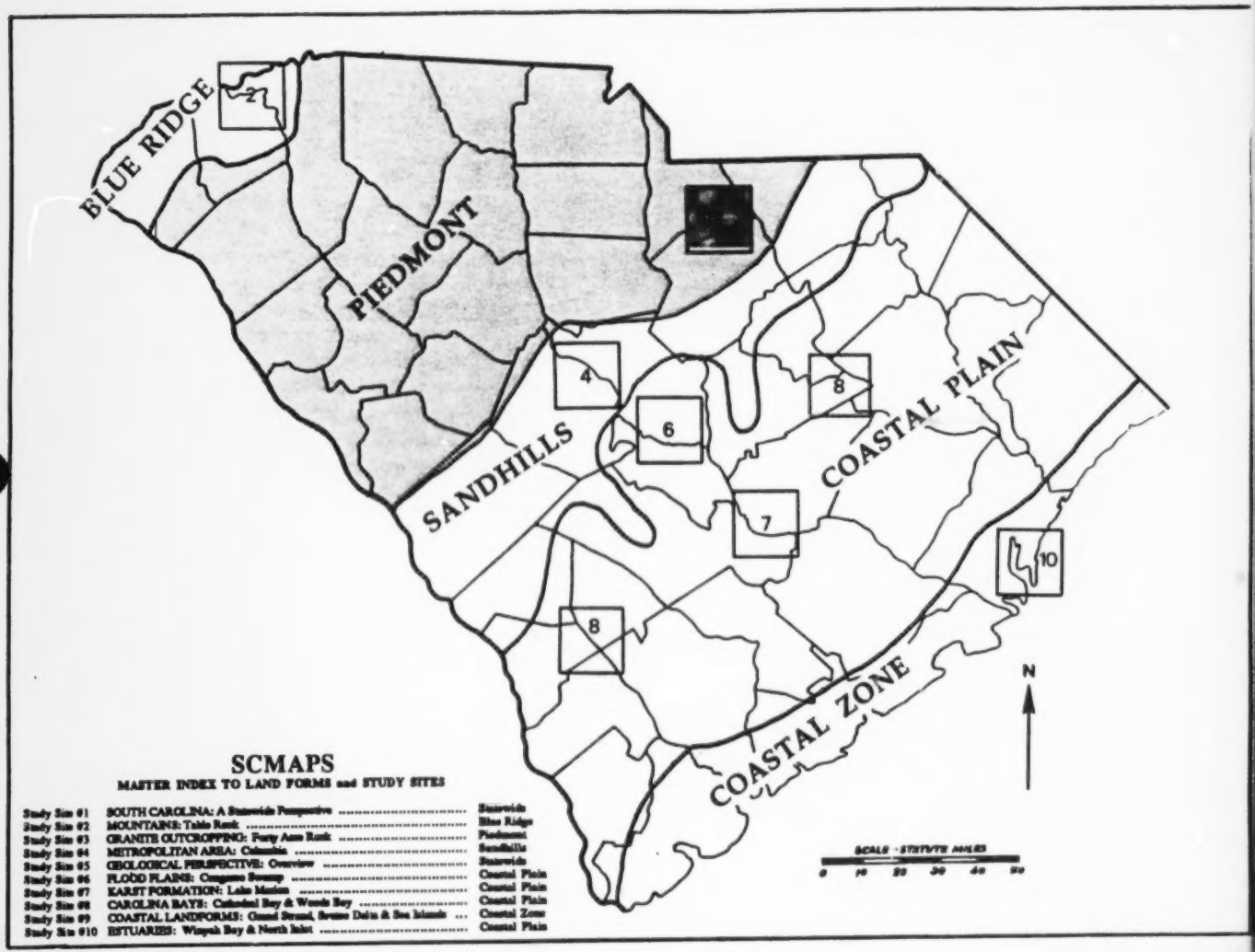
BLUE RIDGE
PIEDMONT
SANDHILLS
COASTAL PLAIN
COASTAL ZONE
1
4
6
7
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8
10
N
SCMAPS
MASTER INDEX TO LAND FORMS and STUDY SITES
Study Site #1 SOUTH CAROLINA: A Statewide Perspective ..... Statewide
Study Site #2 MOUNTAINS: Table Rock ..... Blue Ridge
Study Site #3 GRANITE OUTCROPPING: Forty Acre Rock ..... Piedmont
Study Site #4 METROPOLITAN AREA: Columbia ..... Sandhills
Study Site #5 GEOLOGICAL PERSPECTIVE: Overview ..... Statewide
Study Site #6 FLOOD PLAINS: Congaree Swamp ..... Coastal Plain
Study Site #7 KARST FORMATION: Lake Marion ..... Coastal Plain
Study Site #8 CAROLINA BAYS: Cathedral Bay & Woods Bay ..... Coastal Plain
Study Site #9 COASTAL LANDFORMS: Grand Strand, Seewee Delta & Sea Islands ... Coastal Zone
Study Site #10 ESTUARIES: Winyah Bay & North Inlet ..... Coastal Plain
SCALE - STATUTE MILES
0 10 20 30 40 50

Study Site #3 GRANITE OUTCROPPING: Forty Acre Rock

PIEDMONT - Granite Outcropping: Forty Acre Rock Study Site 3-1

PIEDMONT

STUDY SITE 3

GRANITE OUTCROPPING: FORTY ACRE ROCK

POWER THINKING

You are a Cherokee scout at the top of Forty Acre Rock. Your friend, on the peak of a nearby mountain designated as 618 feet, has just signaled you to come quickly. Using the Taxahaw, SC Topographic Map, identify the quickest and easiest route. How long will it take you to walk this route? Describe the terrain.

RATIONALE

The Piedmont constitutes the second largest of South Carolina's landform regions. It comprises about one-third of the state's total area and has been especially important as a source of economically valuable rocks and minerals, such as granite and gold. Other assets are the rich agricultural land and a prolific source of water power that made possible the development of cotton mills and other early industries. Much of South Carolina's current population growth has been concentrated in the Piedmont, and is due to the increased industrialization and urbanization in the region, especially along the corridor of Interstate Highway 85. Former agricultural misuse of the land created severe erosion problems but the transition from an agricultural to an industrial society has helped to encourage conservation and effective land use planning.

INSTRUCTIONAL OBJECTIVES

1. Identify rock types, soils, vegetation, and landforms which are characteristic of the Piedmont.
2. Examine the effect of stream patterns, relief and slope on gully formation and erosion.
3. Examine agricultural practices of the past which caused additional erosion and eventually led to policies of soil conservation and restoration.
4. Identify areas of historical and modern urbanization and discover reasons for those trends.
5. Examine how dam sites are chosen and why artificial lakes of the Piedmont show a distinctive branching pattern on maps and photos.
6. Locate unique natural preserves and use these examples to illustrate the original vegetation and natural landscape seen by the early settlers.
7. Relate locations of past and present mining activity to the source rocks, methods of production, and use of major mineral resources.

MATERIALS

1	1 NAPP Transparency Forty Acre Rock	1: 40,000
1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Base Map, Shaded Relief	1:500,000
6	Taxahaw, SC USGS Topographic Map	1: 24,000
6	General Soil Map of South Carolina	1:750,000
1	Land Cover/Land Use Map by Watershed (back cover)	
1	State Map of Rivers, Reservoirs, Bays & Sounds (insert)	Study Site 1-4
1	The Geologic Time Scale of South Carolina (insert)	Study Site 1-6
1	Cross-Section of South Carolina (insert)	Study Site 1-7

BACKGROUND INFORMATION

The word **Piedmont** is derived from a French word meaning **Foot of the Mountains**. Although the South Carolina Piedmont certainly qualifies, it is only the northwestern portion that is technically alongside the mountains. The rest of the region stretches over 100 miles towards the southeast in a gradually sloping, mostly flat surface plain. The eastern boundary of the Piedmont Region can be identified by drawing a line on the map from North Augusta on the Savannah River through Columbia and to the place where the Pee Dee River enters South Carolina.

The land surface is quite hilly towards the northwest, where elevations are higher, but becomes more gently rolling at the lower elevations next to the Sandhills Region. Modern rivers, usually wider and flowing more gently than Blue Ridge streams, are actively eroding into the Piedmont causing rather steep-walled valleys with a high relief. Piedmont rivers have branching (dendritic) drainage patterns and are usually full of suspended sediment transported from the mountains. Often, this suspended sediment is temporarily deposited in wide flood plains which provide the rich and very productive soil for agriculture. In between river valleys, the broad upland areas lie essentially flat.

Occasionally, such relatively flat rolling topography is interrupted by deeply dissected stream valleys and a few scattered hills, called monadnocks. These are single mountains, typical of the Piedmont, left comparatively undisturbed by erosion. Monadnocks are usually surrounded by relatively flat ground and can therefore be seen from many miles away. Sometimes these hills are composed of harder rock which would explain their resistance. In other cases it seems to have been pure chance which has allowed them to escape erosion. Because of their elevation over surrounding areas, monadnocks are perfect locations for TV and microwave broadcasting towers. Examples include Paris Mountain near Greenville and Kings Mountain east of Blacksburg.

Piedmont Rock Types

Rock types of the Piedmont are remarkably similar to those of the Blue Ridge Region, differing only in specific mineral content and in regional distribution. Both **igneous and metamorphic rocks** are present in great variety in the Piedmont. Igneous intrusions range in composition from rocks rich in iron and magnesium silicate minerals such as the **gabbro** in Abbeville County to silicate minerals rich in aluminum and silicon such as the **granites** in Fairfield and Kershaw Counties. All such intrusions represent previously molten rock formed deep within the earth's crust during episodes of tectonic activity, primarily due to continental collisions, through the Paleozoic Era. Several of these igneous rocks are mined for monuments, memorials, tombstones, and foundation stone. The most famous is the Winnsboro **Blue Granite** which is mined at the Anderson Quarry near Rion in Fairfield County. Blue Granite has also been designated as our state rock.

Metamorphic rocks, primarily **gneiss and schist**, also vary considerably in their composition throughout the **Piedmont**. But more importantly, they differ in the extent of their metamorphism. Piedmont metamorphic rocks are broadly grouped into four parallel bands crossing the state from southwest to northeast, a trend produced by the pattern of the **Paleozoic Era, Pennsylvanian Period**, continental collisions.

Refer to the Geologic Time Scale and South Carolina and **Cross-Section of South Carolina** in Study Site 1-6 & 1-7. The four belts or parallel bands crossing the state are designated as follows:

Inner Piedmont Belt	Folded, recrystallized during metamorphic state,
Kings Mountain Belt	Less metamorphosed, minerals assemblages, Mined today: lithium, tin, and barium
Charlotte Belt	Moderately metamorphosed contains igneous intrusions,
Carolina Slate Belt	Slightly metamorphosed, originally sedimentary structure Major rocks: sandstone, mudstone, volcanic sediments, granite
	Gold mined from granite

The **Inner Piedmont Belt** is the northwesternmost major division of metamorphic rock. Once a thick sequence of volcanic and marine sediments, these rocks were at the center of the continental collision zone and were the most severely deformed, folded, and recrystallized during regional metamorphism. The **Kings Mountain Belt**, next towards the southeast, is a much less metamorphosed narrow zone containing some rather unique mineral assemblages. Some of the more economically valuable materials being mined today include **lithium, tin**, and **barium**. Those rocks were originally volcanically produced sediments and include some deposits of **quartzite** and **marble**.

The third zone is the **Charlotte Belt**, a moderately metamorphosed region which contains the majority of the igneous intrusions found in the Piedmont. The final zone, at the southeastern edge of the Piedmont, is the **Carolina Slate Belt**. Rocks in this region have been only slightly metamorphosed and can contain some original sedimentary structures and some occasional fossils. The major rock types are **sandstone, mudstone**, and **volcanic sediments**, although some large granite bodies occur in this zone. All of the current gold mining in South Carolina is from granite found in the Carolina Slate Belt.

Gold

South Carolina has become one of the largest producing **gold** mining states east of the Mississippi River. Active **gold mines are located in Lancaster County**, the Piedmont Mining Company (Haile Gold Mine); **Chesterfield County**, the Brewer Gold Company; and **Fairfield County**, the Ridgeway Mining Company. The first "gold rush" in the United States started when a 7.7 kg nugget was found in the Piedmont section of the Carolinas in 1799. This was fifty years before the "gold rush" in California. The site was in what is now North Carolina. By 1802, the first gold was mined in Greenville with the first shipment leaving the Haile mine in 1829. About the same time, the Brewer gold mine in Chesterfield County reached its peak. The Dorn gold mine in McCormick County was discovered in 1835 with peak production occurring in about 1859. During the War Between the States, Billy Dorn outfitted an entire company of Confederate soldiers from the profits he made from gold. Products of the Haile Gold Mine were used by the Confederate Army to finance the war effort. As a result, Sherman made a special effort to destroy the buildings and equipment during his historic march through the South Carolina. It was not until the 1970s when the price of gold skyrocketed and new mining processes were designed, that the gold mining industry in South Carolina was revitalized. The process is expensive as it takes about 20 to 30 tons of rock to extract one ounce of gold using a chemical dissolving process.

Soil Erosion Region

For many millions of years, the Piedmont has been an erosional region. Only in a few stream valleys and floodplains can any thick depositional sequences be found. Otherwise, soils have generally formed directly from the underlying crystalline rocks. Most of these soils are moderately deep, well-drained and very rich in clay. Insoluble iron and aluminum oxides cause the red to reddish-yellow color often seen in the subsoil. The high clay content contributes to the compact nature of most Piedmont soils which prevents them from easily absorbing rainfall. As a result, most heavy precipitation runs off the land creating a high risk of serious soil erosion.

Piedmont soils are considered only fair for typical row crop agricultural use. At one time much of the land was not thought to be fertile. The leaves on the cotton crop developed rust colored spots while the leaves on the corn curled in a pattern called frenching. After the soil was examined in the late 1800s, it was found to be lacking in potash. When this fertilizer was added to the soil, it became as productive as any in the state.

Unique Natural Areas

Located within the Piedmont are several Heritage Trust Preserve sites containing landforms that create special environmental conditions for unique plants. **The John de la Howe Museum Tract** in McCormick County surrounds a special school for children, which has been operating for nearly 200 years. The grounds contain areas of virgin forest, uncut for over 300 years, which include the largest shortleaf pines in the state. **The Stevens Creek Preserve**, also in McCormick County, is one of the state's most diverse and unique historical areas. The well-drained north-facing slope and acidic soils favor a cooler, wetter habitat than is usually found in the Piedmont. Both wildflowers and large trees resemble plant communities usually found much further north. **The Flat Creek Preserve** in Lancaster County which surrounds Forty Acre Rock is actually only 14 acres. It is a massive exposure of solid bare granite with no significant soil layer to hold moisture. Consequently the granite surface strongly resembles habitats normally found in deserts. Moreover, slight depressions in the granite, formed by chemical weathering, can hold water temporarily after a rain. It is in these pools that small, fragile plants and animals slowly build even more complex communities. Surrounding the granite exposure is a vast pine forest and a nature trail three miles long. **Forty Acre Rock is a typical example of granite outcropping found in the Piedmont Region of South Carolina.**

Historical Overview

During the colonial period of South Carolina's development, it was mostly farmers who settled in the Piedmont Region. They arrived with a pair of horses or yoke of oxen, a small wagon load of household goods and farm tools, and a few cattle, hogs, and chickens. Many received land grants for small farms of around 175 acres. They preferred hillside locations near creeks rather than large rivers. Often the rivers flooded the bottomlands making the rivers hard to cross. Smaller creeks could easily be crossed providing more mobility to the settlers. Many natural springs in the hillsides provided a good source of water. The early settlers arrived in the winter months so that a shelter could be built and a few acres of land cleared in time to plant a spring crop of corn and other food. As time went on apple and peach trees were planted which provided cider and brandy. The soil was very rich at first but soon became depleted with continuous planting of crops and subsequent soil erosion. Later when cotton was introduced, it was planted extensively and caused increased erosion and more depletion of soil nutrients.

By the 1930s, the Piedmont had become so gullied and scarred that most of the topsoil had been removed and much of the land was no longer suitable for cultivation. The problem was so bad that several federally sponsored soil conservation demonstration projects were established in South Carolina. One of the earliest of these projects was the Berry Gully restoration project in Spartanburg County which attempted to halt the rapid advance of a gully 60 feet deep and over half a mile long. Also, the first Soil Conservation District Plan in America was instituted on the Adams Farm in Oconee County. Such efforts, combined with the planting of millions of pine trees and the construction of farm ponds and other water retention structures, have helped slow down the rate of soil loss considerably.

Cotton Mill Towns become Industrial Regions

Even though for years, the agricultural area almost single-mindedly was concerned with growing cotton, the **Piedmont Region** was still able to become an early industrial region because of the wide availability of water power. Almost every stream, at every falls or shoals, was dammed to provide power for water wheels to run cotton mills. Small mill towns flourished for years, even after cotton was no longer a profitable crop. Textile mills have consistently been the Piedmont's most important industry. Recently, with improved transportation systems, educational opportunities, and governmental promotion and incentives, South Carolina has attracted an increasingly diverse set of industries and businesses to the Piedmont area, especially to the Greenville-Spartanburg metropolitan area. With the textile mills came environmental concerns. At one time the Reedy River was nicknamed "Rainbow River" due to the dyes poured in the rivers from various plants. Now tighter controls coupled with public awareness are eliminating many of these problems.

Dams Built for Hydroelectric Power

South Carolina was also an early leader in the development of hydroelectric power. Since 1900, several large lakes have been constructed for that purpose along most of the major rivers which flow through the Piedmont. Lake Hartwell on the Savannah River and Lake Greenwood on the Saluda River are prime examples. Lakes such as these provide benefits far beyond hydroelectricity. Recreation, tourism, and flood control are three immediate benefits which have been important to regional development. Many of these lakes have also become centers for retirement homes or bedroom, communities where people live while working in nearby cities. A large amount of water front real estate is produced by the flooding of these river valleys. Some of the environmental effects have been the loss of forest and agricultural bottomland, increase in thermal pollution, and controlled stream flow.

The Naming of Rock Hill

It is interesting to note that the necessity for railroad transportation brought on by the extensive cotton crop caused numerous towns to be founded and helped open the **up country**. It was the granite outcropping coupled with the coming of the railroad that was the basis for naming an important Piedmont city, Rock Hill. When the railroad was first surveyed, the train was to have gone through the community of Ebenezerville. The townspeople refused to sign right-of-ways, as they feared the train would frighten their people and smoke would destroy the beauty of the community. The railroad line was moved to a rocky knoll nearby. While the railroad construction gang was blasting the cut through the area, they referred to it as rock hill. When they reached a specific place, some one asked "what shall we name this place," the supervisor of the railroad said, **Rock Hill**. This city has grown and prospered while encompassing Ebenezerville (Ebenezer) as one of it's nicer residential areas.

Underground Storage in Granite

An interesting use of the underground granite formation is the storage of propane in the York County community called Tirzah. Two caverns dug out of solid granite 450 feet below the earth's surface are used as storage for millions of gallons of propane. Trucks and trains arrive daily and are loaded with propane to service a large region of the southeast. A six inch pipeline is also used to transport the fuel.

Summary

The Piedmont is a region of South Carolina which seems to be continually in transition. After decades of severe soil erosion, it is the place where successful soil conservation has been pioneered. After domination by cotton and the milltown economy, it is the place where new industry and urbanization is flourishing. After free-flowing streams offered the promise of virtually unlimited water power, it is the region where almost every stream has been dammed, and where we have altered not only the stream flow but also the vegetation, animal habitat, sediment transport balance and even local weather conditions. The Piedmont Region contains very few places that preserve the original natural setting. As human modification continues, as it unquestionably will, we must be sure that those natural areas are not lost by neglect or apathy.

INSTRUCTIONAL STRATEGIES

ACTIVITY A PIEDMONT LANDFORM OVERVIEW

Materials

1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Base Map, Shaded Relief	1:500,000
6	General Soil Maps of South Carolina	1:750,000
1	State Map of Rivers, Reservoirs, Bays & Sounds (Insert)	Study Site 1-4
1	Package of Tracing Paper	

Activities

1. Examine the State of South Carolina Base Map with Highways to locate Forty Acre Rock. It is south of the small town of Taxahaw near Flat Creek. Name the county.

2. Using either the State of South Carolina Base Map with Highways or the Relief Map, identify the eastern boundary of the Piedmont Region. Draw a line on the map from the North Augusta area on the Savannah River through Columbia and to the place where the Pee Dee River enters South Carolina. Identify several cities that fall on this boundary line. This is the fall line zone and separates the Piedmont from the Sandhills regions of South Carolina.

3. On the State of South Carolina Base Maps, locate Interstate Highway 85 and the Southern Railroad line (now Norfolk-Southern) running parallel to the highway. Name four large Piedmont cities that these major transportation lines run through.

4. Now looking at the State Map of Rivers, Reservoirs, Bays & Sounds (South Carolina's Intriguing Landscape 1-4) locate these same four cities. How were you able to locate them on the map? Most Piedmont towns began as small mill villages located near sources of water power. Go back to the State of South Carolina Base Map and identify the river or stream in each of the four cities you located previously. What were the most likely sources of water power? Also locate the towns of Lancaster Mills (Lancaster County) and Pacolet Mills (Spartanburg County). On which rivers are those two towns located? What effect did the building of the railroads have on the development of all these cities?

5. Using the State of South Carolina Base Map with Highways, locate the gold mines in Jefferson, Chesterfield County; north of Kershaw, Lancaster County; Ridgeway, Fairfield County, and McCormick, McCormick County. What is the pattern formed for the location of these gold mines? What is the direction of this pattern? How does that compare to the landform regions of South Carolina? Name the belt where gold mines are found. Which rock contains the gold?

6. Examine the State of South Carolina Shaded Relief Map. Look over the Piedmont Region. Where are the steepest slopes found in the Piedmont? How can you identify the steepest areas? Why are these areas so steep?

7. Examine the General Soils Map of South Carolina. Which map colors represent the Piedmont Region? Name the counties in South Carolina that are located in the Piedmont Region. Locate the map legend and read the descriptions of those particular soils. Name the original rock types which produce each of those soil associations.

8. Recently erosion problems in the Piedmont have been handled using the watershed concept. The watershed is defined as the entire drainage basin of a particular stream. Flood prevention and erosion control over an entire drainage basin have proved much more effective than attempting to correct isolated trouble spots individually. Why is it easier to deal with the entire stream system rather than with isolated locations? The first major Soil Conservation Service watershed project in South Carolina was the Twelve Mile Creek Pilot Project in Pickens County, started in 1954. On the state base map, locate Twelve Mile Creek. Place tracing paper over the map, trace all streams which are part of its drainage basin. Approximately how many square miles of land are drained by this stream system?

9. Now look at the computerized State Map of Rivers, Reservoirs, Bays & Sounds. Locate the Twelve Mile Creek drainage basin on that map. Compare its size with other drainage basins nearby. How does it compare? Compare its size to other Piedmont drainage basins further to the southeast. How does it compare with them? Explain your answer.

ENRICHMENT ACTIVITY

1. Write to one of the gold mining companies and ask for a sample of gold ore. Investigate the history of gold mining in South Carolina and the processes by which gold is mined today. How do the processes differ? Explain why gold mining is more profitable today than it was 10-20 years ago.

ACTIVITY B **FORTY ACRE ROCK AND FLAT CREEK PRESERVE**

Materials

1	1 NAPP Transparency Forty Acre Rock	1: 40,000
6	Taxahaw, SC USGS Topographic Map	1: 24,000
1	Land Use/Land Cover Map by Watershed (back cover)	
1	State Map of Rivers, Reservoirs, Bays & Sounds (insert)	Study Site 1-4
1	Package Tracing Paper	

Activities

1. Locate Forty Acre Rock on the Taxahaw Topographic Map. Also locate the rock on the infrared transparency. Which is easier to find? Why?

2. Just south of Forty Acre Rock, Flat Creek makes two extremely sharp bends near the word "Flat" on the map. Flat Creek cuts through a ridge at this point. What kind of rock or mineral composition do you think the ridge might be made out of? Why? Why does the river turn so sharply here?

3. Most Piedmont lakes are formed by building dams along natural constrictions in the stream's flow. The ridge you just located represents such a constriction. Assume that the Corp of Engineers has decided to build a dam on Flat Creek at the location of the ridge. Assume that the top of the dam will be even with the 400 ft. elevation contour line. How deep will the water be just west of the dam? Explain. Place a piece of tracing paper so that the lower right hand corner of the paper sits near the site of Flat Creek School at the town of Midway in the lower right hand portion of the Taxahaw Topographic Map. Starting at the north end of the dam, trace the new shoreline (the 400 ft. contour line) around Flat Creek until you circle completely around to the south end of the dam. The outline you just drew represents the typical configuration of an artificially constructed Piedmont lake. Compare the pattern of your tracing with the outlines of several Piedmont lakes shown on the computerized reservoirs and streams by watershed map. Why is this characteristic pattern produced?

4. Piedmont areas vary considerably in slope depending on how close the land is to major streams. Make two topographic profiles using ten foot intervals for the vertical axis. The first section line should run from New Zion Church along Highway 522 a half mile north of Union (upper left quarter of map) to the letter "B" in the word "branch" half a mile south of Highway 9 in that same quarter of the map. The second section line should run from Forty Acre Rock to Highway 601, half a mile west of the eastern map edge (near the 474 elevation mark). What are the major differences in terms of map location? Where are erosion gullies most likely to form? Why?

5. Locate several farm ponds on the Taxahaw Topographic Map, especially on the left half of the map. What do they all have in common? Why are they located where they are? What benefits do farmers receive from such ponds?

6. Locate an area on the Taxahaw Topographic Map with stream valley bottom land. Next, locate an area of higher elevation flat land. Which area would produce the best agricultural land? Why?

ENRICHMENT ACTIVITY

1. Write to the Chamber of Commerce of the following cities and ask them how the town got its name, what kind of mill originally operated, and whether the mill is still operating.

Lancaster Mills; Lancaster, SC; Lancaster County
Winnsboro Mills; Winnsboro, SC; Fairfield County
Baldwin Mills, Chester County
Lydia Mills; Clinton, SC; Laurens County
Inman Mills; Inman, SC; Spartanburg County
Monarch Mills; Union, SC; Union County

PLACES TO VISIT

- John De La Howe Museum Tract in McCormick County is located on Little River and Clarks Hill Reservoir. Visits can be arranged by calling (803)391-2131.
- Stevens Creek Heritage Preserve (McCormick County)
- Molly's Rock Recreation Area (Newberry County)
- Flat Creek Preserve/Forty-acre Rock (Lancaster County)
- Kings Mountain State Park, located in York and Cherokee Counties On SC Hwy. 161, 14 miles northwest of York, is the site of a re-created 1840 Carolina upcountry farm. Adjacent to the park is the Kings Mountain National Military Park, a prominent Revolutionary War Battle site. For information call (803)222-3209.
- Several gold mines provide tours for students groups, from time to time their policies change. Perhaps visits can be arranged by making prior contact.

Brewer Gold Company	(803)658-3039
Piedmont Mining Company	(803)475-1220
Ridgeway Mining Company	(803)252-2550

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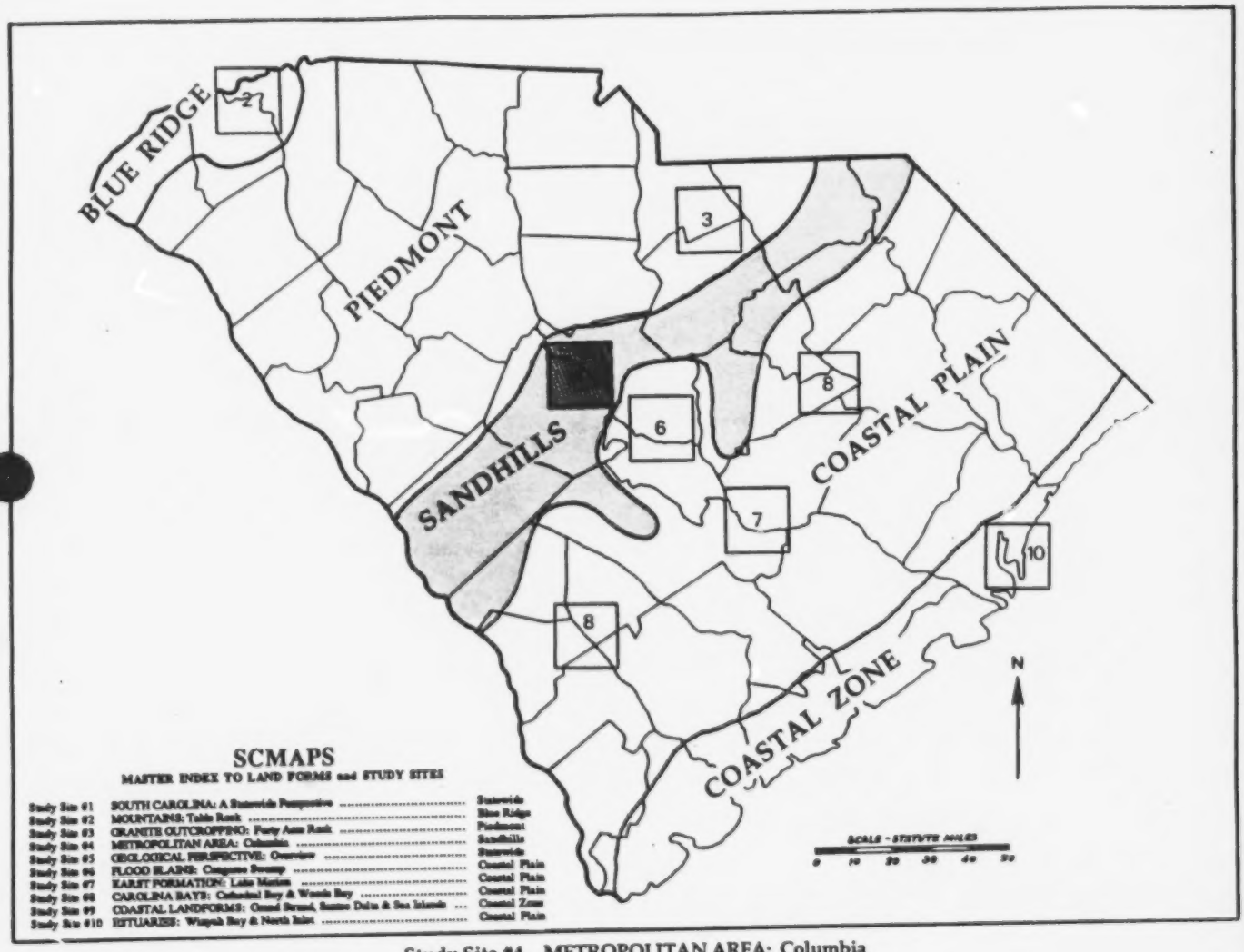
BLUE RIDGE
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SCMAPS
MASTER INDEX TO LAND FORMS and STUDY SITES
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Study Site #4 METROPOLITAN AREA: Columbia

BEST COPY AVAILABLE

SANDHILLS

STUDY SITE 4

METROPOLITAN AREA: COLUMBIA

POWER THINKING

You are the president of "Save the Congaree," a group dedicated to preserving as much of the Congaree River in as close to a pristine state as possible. Knowing that the Congaree River flows into Congaree Swamp National Monument less than 20 miles downstream from Columbia, you are concerned that the city might be causing problems in the swamp. By looking at the infrared photograph of Columbia, what can you see along the Saluda, Broad, and Congaree rivers that might affect the quality of the water downstream?

RATIONALE

The South Carolina is an interesting geographic area of the state as it combines two distinct geologic provinces of different origins. These are separated by the fall line zone which can easily be identified as the boundary along which the Piedmont gives way to the Coastal Plain. The resulting landforms have influenced the historic development of the capital city, Columbia, a major urban metropolitan center in this region. Additionally, the urban landscape of Columbia provides an interesting view of the relationship between people and their environment. In this series of exercises, we will take a closer look at some of the more interesting elements of the Columbia metropolitan landscape, which have influenced its development and culture.

INSTRUCTIONAL OBJECTIVES

1. Recognize the geological processes that have sculptured the landscape of the Columbia metropolitan area and how they have influenced its historical development.

2. Identify and locate the sandhills area of South Carolina, which is the boundary between the Piedmont and the Coastal Plain, and is often called the Fall Line Zone.

3. Classify the landform regions that make up the Columbia Metropolitan area indicating whether they belong to the Piedmont or the Coastal Plain.

4. Examine the way early Columbians' harnessed the river system for transportation and later for hydro-electric power.

5. Recognize famous Columbia landmarks.

6. Identify major urban land uses of the Columbia metropolitan area including commercial, industrial, transportation, residential, utility, institutional, and recreational.

MATERIALS

1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Base Map, Relief Map	1:500,000
6	Columbia North, SC USGS Topographic Map	1: 24,000
6	Southwest Columbia, SC USGS Topographic Maps	1: 24,000
1	NHAP Photograph Columbia Metropolitan Area	1: 58,000
1	Columbia, 1850 (Unit 4-5)	
1	State Map of Rivers, Reservoirs, Bays, & Sounds (Unit 1-4)	

BACKGROUND INFORMATION

Landforms Dictated Development of Columbia

Columbia's present landscape was shaped by the geological processes that took place millions of years ago. These processes and their resulting landforms have clearly shaped the past and present land use of the current metropolitan area. When early settlers began to make an imprint on the land, there were many good reasons for the development of Columbia along the river banks of major waterways like the Broad and Saluda Rivers which drain central South Carolina. **The placement of early structures such as cotton mills, the Columbia Canal, rock quarries, the relocated capital, and railroad junctions along the banks of this river system were not just by chance.** It was due to the effects of the **underlying geological formations** along with surface erosion which provided a distinctively sculptured landscape. The merging of the Broad and Saluda Rivers out of hilly terrain west and north of Columbia to form the meandering Congaree River, located in a flat terrain, contributed to the development of Columbia as a major metropolitan center by making the area accessible for transportation of farm products by way of the river system and roads to Charleston. Ultimately, the Carolina midlands became the state's center for trade, transportation, governmental affairs, cultural enhancement, manufacturing, and the home office of many businesses.

The Columbia study site is unique as it is geographically situated on two different geological provinces which are separated by the fall line zone characterized by the sandhills landscape. This band of rolling topography runs in the Northeast-Southwest direction corresponding to an ancient shoreline which existed over 50 million years ago. The sandhills overlap the fall line zone which geologically separates the **Piedmont Province** from the **Coastal Plain Provinces** of South Carolina. This same distinct geological formation runs through Richmond, Virginia; Raleigh, North Carolina; Columbia, South Carolina; Augusta, Georgia; and Montgomery, Alabama. This list includes several state capitals.

In more recent years, the Columbia area has been called the **Midlands** because of its central location. Yet, **Sandhills** best describes the fall line zone running through central South Carolina with its sandy soil. The sandhills run diagonally through South Carolina in a band parallel to the Piedmont Region. **This band includes Aiken, Barnwell, Lexington, Richland, Kershaw, Chesterfield Counties**, and the northeast tip of **Marlboro County**. A very small part of the Sandhills Region dips into **Allendale, Bamberg, Orangeburg, Sumter, Lancaster, and Darlington Counties** making a wide band running through the state. Because it covers 11% of South Carolina, SC MAPS has used **Sandhills** to indicate this area. Both names can be used to designate the greater Columbia metropolitan area.

Another important factor that has shaped the Columbia metropolitan area is the river system. The **confluence of the Broad and Saluda Rivers to form the Congaree River** is part of the expansive Santee River basin which drains central South Carolina. This river system provided Columbia with an important transportation link with Charleston in the early days of South Carolina's development.

Fall Line Zone - Identified by Sandhills and River Rapids

Extending into and around the Columbia metropolitan area is the rolling hills topography known as the **Carolina Sandhills**. These rounded gentle sloping hills are the remains of sandy and clayey sediment **deposits left between 55 and 100 million years ago when the Atlantic Ocean covered a large portion of eastern and southern South Carolina.** The sandhills correspond to the ancient shoreline, which is recognized today by old dune remnants. During that ancient era, weathering and erosion of the Blue Ridge and Piedmont soils provided clays and sands that were carried by water and deposited at the mouth of the rivers. Ocean processes such as waves and tides reshaped the sediments to form beaches and sand ridges the remains of which are present today. Marine sediments were also deposited offshore, in the ancient flooded coastal plain region, creating the nearly horizontal strata of sedimentary rocks that is characteristic of the present day Coastal Plain Province. The **Fall Line Zone**, easily identified in the NHAP photograph by the river rapids located along both the Broad and Saluda Rivers, forms the boundary between the more resistant rocks of the Piedmont Province and the more easily eroded rocks of the Coastal Plain Province. The rapids identify a significant drop in elevation between the two provinces.

The soil of the Carolina sandhills is classified as having sandy texture. This type of soil is well drained and subject to rapid leaching. Due to leaching, the sandhills region is generally not considered to be a productive agriculture area because of the rapid loss of nutrients, organic materials, and water which limits the productivity needed for intensive agriculture. However, the Sandhills natural area is well suited for vegetation such as long leaf pine and turkey oak forests, which easily adapt to water-starved conditions.

In the western part of the Sandhills Region, particularly in Aiken County, large deposits of kaolin clay have been mined extensively. This clay is of great economic importance in South Carolina and is used unprocessed in the **manufacture of bricks and refractory materials and processed in such diverse industries as rubber, paint, paper, fertilizer, and pesticides**. Many millions of years ago, abundant feldspar mineral grains in exposed granite landscapes were altered to the mineral kaolinite through chemical weathering processes. The loosened grains were transported by water and deposited as thick layers which were then buried by other sedimentary deposits and turned into rock. Modern erosion has uncovered the clay deposits providing easy access for today's mining activities.

The **Southern portion of the Columbia** metropolitan area, Southwest Columbia topographic study map, shows **excellent examples of Coastal Plain landforms**. After leaving the Fall Line Zone at Columbia, the **Congaree River begins to take on a much different character than the rivers of the Piedmont**. Broad meanders, extensive floodplains, cut-off oxbow lakes, and swamp-like vegetation are evidence of the change.

Location of the Capital Moved to Columbia

By 1785, bowing to increased pressure from the up country, the **South Carolina Legislature decided to move the state's capital** inland from Charleston. The location of the capital was hotly debated, however, Senator John Lewis Gervais and Representative Henry Pendleton carried the day with their suggestion of a site near **Friday's Ferry** on the **Congaree River** which included the plain of a hill then owned by Thomas and James Taylor. The Congaree River had always provided transportation into the up country, to the junction of the Broad and Saluda Rivers. This had proven to be a natural spot for a trading center as early as 1718. The town of Gramby had developed on the western shore near the headwaters of the Congaree River by 1748. To ridicule the up country wilderness settlers, Charlestonians suggested that the site be called, "Town of Refuge," but Gervais responded that he "hoped that the oppressed of every land might find a refuge under the wings of Columbia." **The name Columbia was chosen over Washington** by an 11-7 vote in the Senate. The General Assembly met in Columbia for the first time in January, 1790, in a wooden State House. During the writing of the State Constitution of 1790, Charles C. Pinckney tried to have the capital moved back to Charleston, however, Columbia became the permanent capital by a vote of 109-105.

Reproduced from:

Jones, Lewis P. (1985). South Carolina One of Fifty States. Orangeburg, SC: Sandlapper Publishing, Inc.

COLUMBIA, 1850

Naming Columbia Streets

Columbia was originally the site of the plantations owned by Thomas and James Taylor. It was (insert map Columbia, 1950) laid out from the State House with wide streets named **Assembly** and **Senate** for the two branches of the legislative body. The streets eastward and parallel to Assembly Street were named for South Carolina Revolutionary War generals **Sumter, Marion, Bull, Pickens, Henderson, Barnwell, Winn, and Laurens.** Parallel to Assembly heading toward the Congaree River, the streets were named for Continental Generals: **Gates, Lincoln, Gadsden, Wayne, and Pulaski.** Gates subsequently was renamed **Park.** Parallel to Senate Street going from the State House Northward, most of the street were named for prominent citizens **Gervais, Lady, Washington, Plain, Taylor, Blanding, Laurel, Richland with Pendleton and Greene** on the south side. George Washington and his Lady, Martha, were honored by street names parallel to Senate. Plain and Richland were named after the Taylor plantations. Plain was later changed to **Calhoun.** Street south of the State House were given the names of agricultural products of South Carolina: **Blossom, Wheat, Rice, Tobacco, and Indigo.** After the University of South Carolina was established in 1801, **Medium** was renamed, **College Street.** Originally **Main Street** was named **Richardson** after the Revolutionary War general, however in later years it was renamed. The Capitol complex carries his name and is called **Richardson Square** (Jones, pages 335-6 & 406).

Columbia Canal

The War of 1812 demonstrated the inadequacy of the nation's internal transportation system and John C. Calhoun strongly supported Henry Clay in his drive to provide federally-funded internal improvements. But even after the **economic success of the Erie Canal launched the Canal Age**, the states and not the federal government funded most of the internal improvements. South Carolina was no exception. In 1818, **South Carolina** committed a total of $1,900,000 toward improvement programs. One **major project was the Columbia Canal** which was begun in 1819 and completed in 1824. The canal was needed to overcome a river fall of 34 feet. This drop in topography created rapids beginning two miles above the city and ending one mile below. The Columbia Canal was originally 3 1/8 miles long beginning in the area between Lumber and Richland Streets and ending across from Gramby's landing.

The growth of the railroad soon made water transportation and the canal system obsolete. No longer a water trade route, the Columbia Canal became a source of hydroelectricity. The power plant built at the base of the Columbia Canal generated electricity to made gun powder, ran a grits mill and a state dispensary, pumped water for Columbia, and operated a saw mill.

In 1891, the original canal was enlarged and extended several miles northward to increase it's power-generating capacity. In 1893, the Columbia Mills Company selected a site beside the canal on Gervais Street to locate their duck cloth (coarse cotton) manufacturing plant. **The powerhouse constructed at the canal supplied power for 14 alternating-current motors** within the mill. Manufacturing at the world's first electrically operated mill began on June 11, 1895. Later it became Mt. Vernon Mill and is **now the site of the South Carolina State Museum.**

The Siege of Columbia

Toward the close of the **War Between the States** (as it is known by Southerners), the **Union General, William T. Sherman, made his infamous march through the South.** He left Savannah, Georgia, heading toward Columbia, intending to make this city a prime target, because it was the capital of the first state to secede from the Union. As **Sherman and his troops crossed the state, they pillaged and destroyed mansions, homes, barns, fields, and forests** in their path. It is reported that columns of smoke marked his progress. Sherman arrived in Columbia, February 16, 1865, on his way to North Carolina. The following excerpt is taken from Sherman's personal diary.

Early next morning (February 16) the head of the column reached the bank of the Congaree opposite Columbia, but too late to save the fine bridge which spanned the river at that point. It was burned by the enemy. While waiting for the pontoons to come to the front, we could see people running about the streets of Columbia occasionally small bodies of cavalry, but no masses. A single gun of Captain De Gress' battery was firing at their cavalry squads, but I checked the firing, limiting him to a few shots at the unfinished state house walls, and a few shells at the railroad depot to scatter the people who were seen carrying away sacks of corn and meal that we needed. There was no white flag or manifestation of surrender.

In Sherman's diary the "enemy" he referred to were a group of South Carolinians defending their city. Today, **six brass star makers on the South Carolina State House facade indicate the damage to the structure** done by Captain De Gress' twenty-pound Parrots in 1865. The shells were fired across the Congaree River from what is now West Columbia. The Congaree River at that time was too broad and swift for a safe crossing, Sherman ordered his troops to go north and cross the Saluda and Broad rivers which were less treacherous. It is also reported that **Sherman and his troops spent the night on an island close to the present site of the Riverbanks Zoo.**

In articles written by Henry A. Rogers, he described Sherman's stay in Columbia.
On February 17 Sherman and his men entered Columbia and remained there three days destroying the great beauty of many fine town houses and public buildings. Controversy still reigns as to whether Sherman gave the order for the city to be burned or whether drunken soldiers did it out of wantoness of spirit. Nevertheless, the once magnificent and proud capital city of the first state to secede from the Union stood in ashes and shambles when the Union army departed on February 20.

Another account of those dark days indicates that many people thought Sherman was going to Charleston from Savannah to pillage that city. Consequently, a large supply of spirits had been shipped to Columbia for safe keeping by the Charleston merchants. This factor is through to have contributed to the drunkenness of the soldiers. From Columbia, Sherman's and his troops went to Winnsborough (Winnsboro) in Fairfield County, crossed the Wateree River at Rocky Mount in Chester County and marched on to Cheraw. From there they went to Bennettsville destroying and pillaging a 60 mile wide path through South Carolina.

Summary

Columbia is in the geographic center of the state, and it was selected as the capital city primarily because it was the junction point of two major rivers, the Broad and Saluda, which made it accessible to a large number of South Carolinians. Running through Columbia is the fall line zone which separates the Piedmont or **up country** from the Coastal Plain or **low country**. This fall line zone is characterized by sandhills. The areas is steeped in history as shown by once having been visited by George Washington in 1791, devastated by Sherman during his siege in 1864, and been the site of the first electrically operated mill in 1895.

Today, Columbia like other urban and suburban metropolitan cities in South Carolina needs services and resources to support its large population and busy economy. Water is needed for industry, households, and transportation of wastewater. Electricity and natural gas are needed for industrial and residential use. Transportation facilities such as airports, highways, and railroads are needed to link the people and resources. Space and land is needed for housing, businesses, factories, shopping centers, and utility corridors in urban areas. Specifically, Columbia is fully supported by the surrounding landscape, including forest land for timber, agricultural land for row crops and dairy products, and mining sites for building materials. Careful attention must be paid to the possibility of over stressing the resources of the areas.

INSTRUCTIONAL STRATEGIES

ACTIVITY A LANDFORM OF METROPOLITAN COLUMBIA

Materials

1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Base Map, Relief Map	1:500,000
6	General Soil Maps South Carolina	1:750,000
1	Package of Tracing Paper	

Activities

1. Using the State of South Carolina Base or Shaded Relief Map, identify the boundary of the greater Columbia metropolitan area study site. Locate the Piedmont, Sandhills, and Coastal Plain landforms and the boundaries between them. Make a comparative list of the differences in landscape characteristics such as drainage, topography, elevation, soil types, land usage, and vegetation types between these landforms.

2. Looking at the State of South Carolina Base Map, name the rivers that drain metropolitan Columbia. Explain the reasons why Columbia was an obvious choice for selection as the Capitol of South Carolina. Would this be a good choice today?

3. Using the General Soil Map, identify the counties that are located in the sandhills. What percent of the soil in South Carolina is classified as sandhills? What is the topography of the sandhills? What kind of vegetation is typically found in the sandhills? If you live in the Coastal Plain region or on your next visit, identify an area that is typically sandhills vegetation.

4. Using the Columbia North and Southwest Columbia USGS maps, identify the Piedmont and Coastal Plain landform regions by using contour intervals. In which landform region do you find most of the residential area? Industrial area? Was this just a "happen so?" Give some reasons for your answer.

5. What factors influenced Sherman's decision to cross the Saluda and Broad rivers instead of the Congaree River. Was this a wise decision? Why? (Read pages Sandhills 4-4 to 7)

ENRICHMENT ACTIVITIES

1. Research the ecological systems of the Congaree, Saluda, and Broad Rivers noting the different types of fish and aquatic habitats. What natural or man-made features affect each and how? Name the recreational usage you would expect to be associated with the rivers? Describe a typical natural food chain for a large river. How are these rivers used today?

2. During the Canal Age, South Carolina appropriated money for the development of canals. Research these locations and locate them on the state base map (Jones, 1985). What equipment was used to build the canal that would be obsolete today?

ACTIVITY B COLUMBIA NORTH, THE PIEDMONT INFLUENCE

Materials

1	NHAP Aerial Photograph Columbia Metropolitan Area	1: 58,000
6	Columbia North, SC USGS Topographic Maps	1: 24,000
1	Package Tracing Paper	

A Note About the NHAP Infrared Aerial Photograph

The NHAP photograph Columbia taken on March 3, 1983 shows the green foliage varying from bright red to dark reddish-grey. These infrared photographs are often called *false color* maps because green colors appear red. This photograph was taken in early March when the deciduous trees in Columbia were just beginning to sprout with spring foliage and winter ground cover crops had been planted in the fields. Interpretation of the varying reds identifies: bright red as green ground cover such as winter rye, wheat, or oats; red as evergreen trees such as pine; and dark reddish-grey as swampy areas covered with a canopy of deciduous hardwood trees such as oak, hickory, and gum.

A Note About the Use of the NHAP and Topographic Map

As an introduction to this activity, locate the position of the **Columbia North Map** on the State of South Carolina Base Map with the index overlay. Frequently compare the NHAP photograph of Columbia to features on the Columbia North topographic map.

Activities

1. On the NHAP map of the Columbia metropolitan area, identify the rivers flowing through Columbia. In which direction are these rivers flowing? Notice that the Broad River has a lot more sediment (water appears lighter) than the Saluda River. This pattern continues after the rivers join to form the Congaree River. Locate the rapids along the Broad and Saluda Rivers that identify the fall line zone. Locate the Columbia Canal with the dam on the lower end. Identify and name the bridges and highways connecting Columbia with West Columbia and Lexington. What factors do you think were influential in establishing an early settlement in this area?

2. Identify famous Columbia landmarks such as Williams Brice Stadium and Fair Grounds, Owens Field, rock quarries, South Carolina State Museum and Tax Commission Building (near the lower end of the Columbia Canal), University of South Carolina campus, River Banks Zoo, South Carolina Mental Hospital complex, and the South Carolina State House and capitol complex. Identify the streets named after Revolutionary War generals, Continental Army generals, prominent citizens, influential legislators, and important agriculture products.

3. Using the Columbia North Topographic Map, describe the landscape of this portion of Columbia. Is it flat, hilly, or mountainous? Find the highest and lowest elevation points. What is the difference in the elevation of the Broad River at the top of the map and at the place where it merges with the Saluda River to form the Congaree River? What is the elevation of the Capital, Richland Memorial Hospital, Governor's Mansion, Elmwood Cemetery, Columbia Bible College, State Hospital, State Hospital, railroad tracks, and Dutch Square Mall.

4. Locate the major power line right of ways servicing the Columbia North area. Follow these lines across the Saluda and Broad Rivers.

5. Identify the major interstates skirting around Columbia. Determine the amount of land used in acres for the clover leaf at the junction of I-26 and I-20? What feature helps in determining that these are interstate highways? What types of businesses and industries would be attracted to locating near interstates? Why?

6. Using a ruler, divide the map into four equal quadrants. Draw lines and label the regions: A, B, C, and D. The drawing of these divisions is referred to as map sectoring. Contour intervals on this map are shown in 10 foot increments. Examine Quadrant A. Describe the topography of this area. What major water body is responsible for drainage of the land area?
Locate Statestone Creek and Burgess Creek. How is the elevation of the tributaries different from the creeks? What is the direction of water flow in the creeks? Do the creek contour lines point upstream or downstream?
Follow Burgess Creek from Broad River to the drawn quadrant line. What is the highest and lowest elevation? Determine the elevation drop, in feet, of this creek.

7. Locate Graveyard Hill Cemetery in Quadrant A: What is the elevation of the cemetery? What is the elevation of Statestone Creek next to the cemetery? What is the elevation difference? Using the feet scale bar in the map legend, determine the distance in feet from the cemetery to the closest point on the creek. Why do you think cemeteries are built on high ground?

8. Draw a straight line from the Graveyard Hill Cemetery to the northwest corner of the map in Quadrant A. Construct a profile of the topography of this area. Start at the cemetery and proceed northwest to the map corner. Use the bottom horizontal bar of the diagram for distance in feet with the vertical line bar representing topographical relief in 10 foot contour intervals.

9. Locate the railroad tracks in Quadrant A, C, and D. Which railroad line is it? On which side of the river is it located? Name the railroad that intersects it in Quadrant C. (Both railroad companies have changed names since the maps were revised in 1982. The companies are Norfolk Southern and CSX.) Why do both of these railroads tend to follow river systems?
Locate the Mining Processing Plant near intersections of Quadrant A & C. This is a brick processing plant. What South Carolina raw material is used for manufacturing bricks? (see Sandhills 4-4) Why do you suppose the plant is located here? Which type of transportation systems are necessary for this type of an industry?

10. Locate Crane Creek in Quadrant B. Note its flood plain area. Why are there no houses or building located in these areas? If one were to build in this areas, what events would pose a danger to the dwellings and their people? Why might crane Creek Flood quickly? What is the elevation of the small lakes at the top of Quadrant B? Are these natural or man-made?

11. Many of the smaller water symbols (refer to USGS symbols sheet) and tributaries in Quadrants A and B are shown as "dashed and dotted" lines. What type of tributary are these? How does it differ from the solid blue tributary of Crane and Burgess Creek?

12. In Quadrants A and B, what color are the cleared areas such as pasture, housing developments and agricultural fields? What color are the forest or wooded areas?

13. In Quadrant C, locate the Diversion Dam on the Broad River. The dam structure was intended to divert water into a man-made canal running adjacent to the river. This canal was built for transportation purposes in the 1800s as a means of navigating around the river rapids on the fall line zone. Toward the end of the 19th century it was used for generating electricity. This canal will be a focus of the next activity using the Southwest Columbia topographic map.

ENRICHMENT ACTIVITIES

1. Locate the four corners of the Columbia North map. Determine in degrees, minutes, and seconds the difference between East and West as well as North and South. Are they similar? Why are these called 7.5 minute topographic maps. What physical parameters of longitude and latitude would explain the rectangular appearance of this map and other maps in this latitude of the world, when they cover the same geographical areas? What would you expect a similar 7.5 minute map to look like at the equator? Or at a higher latitude towards the North Pole? One minute of latitude is equal to approximately 6,076 feet. What is the distance of this map from North to South? Approximately how many miles is this? Why is longitude not a consistent or accurate distance indicator?

2. Imagine floating down the Saluda River. Describe the terrain of the banks on both sides of the river. Describe the same trip down the Broad River. What kind of industry or plants would you encounter? Compare the two trips.

3. Trace settlement eras in the Columbia area starting with the early Indians through colonial colonization, early industrial and agricultural trade centers, railroad era, and finally the modern era of urbanization, and ex-urbanization trends resulting in the movement of residential areas from the center of Columbia. What natural and cultural resources were involved in each era? Relate specifically the use and impact on the river system in this study site for each era.

4. Identify as many uses of the river as possible. What are the positive and negative impacts associated with the current uses of the rivers? How do these fit into the recreational uses of the river? What concerns would you expect to develop because of extended use of the rivers?

ACTIVITY C SOUTHWEST COLUMBIA, THE COASTAL PLAIN INFLUENCE

Materials

1	NHAP Aerial Photograph, Columbia Metropolitan Area	
6	Southwest Columbia, SC USGS Topographic Maps	1: 24,000

Activities

1. What are the highest and lowest elevation points in the Southwest Columbia map? What is the terrain of this area? Is this part of Columbia hilly, flat, or mountainous? What is the difference in elevation of the Congaree River at the top of the map and at the bottom of the map? In which direction is this river flowing?

2. Locate the site on the west bank of the Congaree River where Sherman's troops fired at the South Carolina State House. Use the map scale to determine the distance that the shells were fired. Locate the islands in the Saluda River where his troops encamped before entering Columbia. Can you see why Sherman chose this site to cross the rivers rather than further south?

3. As the Broad River and Saluda River flow across the fall line zone into the Coastal Plain, the configuration of the topography and drainage patterns abruptly change. Describe how the banks of the Congaree River would appear if you were riding down the river in a ski boat. How does the Congaree River differ from the Saluda and Broad Rivers in appearance and velocity of the water? What relief, topography, and floodplain differences are obvious? Locate the *levee or dike* on the east bank of the Congaree River. Follow the river route. Note the large flat cleared areas east of the levees. Why do you suppose these dikes were built?

4. Identify the major transportation systems on this topographic map such as the railroads, highways, and airports. Trace the railroad lines to the marshaling yards and spurs leading to industries. Name the railroad lines servicing Columbia. Where do the trains cross the Congaree River? Identify the major highways outlined in red on this map. What is the elevation of the Columbia Metropolitan Airport? Owens Field? Which has a higher elevation?

5. Locate the power plant at the top of the map. This is the site of South Carolina's first hydroelectric plant. In fact, it was the first hydroelectric plant in the United States. It was built at the base of the Columbia Canal using water to power the turbines that generate electricity. This facility is still in operation. It powered the first textile mill to be operated exclusively by electricity. The South Carolina State Museum is housed in the old mill building adjacent to the power plant. Note the power lines going in two directions from the power plant. Identify the transmission power lines running along the river. Follow these lines to the substations noting the distribution routes and then on to the residential and industrial areas.

6. Locate the sewage disposal and filtering plants on this topographic map. This can be hastened by identifying the reservoirs on the NHAP photograph by their dark color. Water with dissolved sediments appear on infrared maps to be light blue, while water without suspended and dissolved materials is almost black. Note the two sewage disposal plants, one on the east side and the other on the west side of the Congaree River. These plants filter and treat household, commercial, and storm waste waters before discharging the treated effluent into the river.

7. The Southwest Columbia topographic map was originally made in 1972 and edited in 1982 by photorevisions as indicated by purple markings. Note the concentrations of new large buildings between Olympia and Arthurtown and the connecting railroad spurs. How do you suppose these buildings are used?

8. Note several new *sandpit* and *gravel* mines indicated by purple. What is the connection between the types of mining operations and the sandhills landscape characteristics of the Columbia area? What historical geological event was responsible for the formation of these particular economic deposits? List four uses of this commodity in the Columbia area. What modes of transportation are used to get this product to market?

9. Note the new *rock quarries* located on both sides of the Congaree River. Granite is mined from these quarries. What historical geological processes occurred to make this area suitable for this type of mining? Describe how this commodity is transported. Name four potential uses for granite? If you were at the top of one of these quarries looking down, how many feet would it be to the bottom?

ENRICHMENT ACTIVITIES

1. Research the history of the Columbia Canal and the development of the hydroelectric plant. Explain, using diagrams, how electromagnets are used to generate power. How is electricity transmitted over power lines?

2. Find out how large metropolitan cities handle sewage. How are waste materials removed from sewage? Which chemicals are considered heavy metal contaminants? Is the demand for sewage disposal keeping up with the growth of the city? Compare a metropolitan city waste disposal systems to the treatment used by small towns.

3. Research how a municipal water purification plant treats water before it is sent to customers. Explain each step in the process. What chemicals are added to the water. Why? Explain the purpose of aeration, pH adjustment, and fluoridation.

4. Write an essay entitled "South Carolina 12,000 Years Ago." A visit to the Natural History section of the South Carolina State Museum can be used as a prompt to enrich the essay. Be sure to integrate South Carolina's geologic history and individual creativity.

PLACES TO VISIT

- The hydroelectric plant on the Columbia Canal is operated by the South Carolina Electric and Gas Company. School tours can be arranged upon request.
- The South Carolina State Museum is located in the old Mount Vernon Mills facility which at the turn of the century was the Columbia Mills Company. Call for reservations for an educational tour if you are taking a group.
- The Capitol complex, including the State House and grounds, is an excellent place to see legislatures making decisions about our state. They are in session beginning in mid-January through April or May. In order to catch the State of South Carolina lawmakers in action, contact the State House, or the representatives or senator from your county for scheduling student trips.

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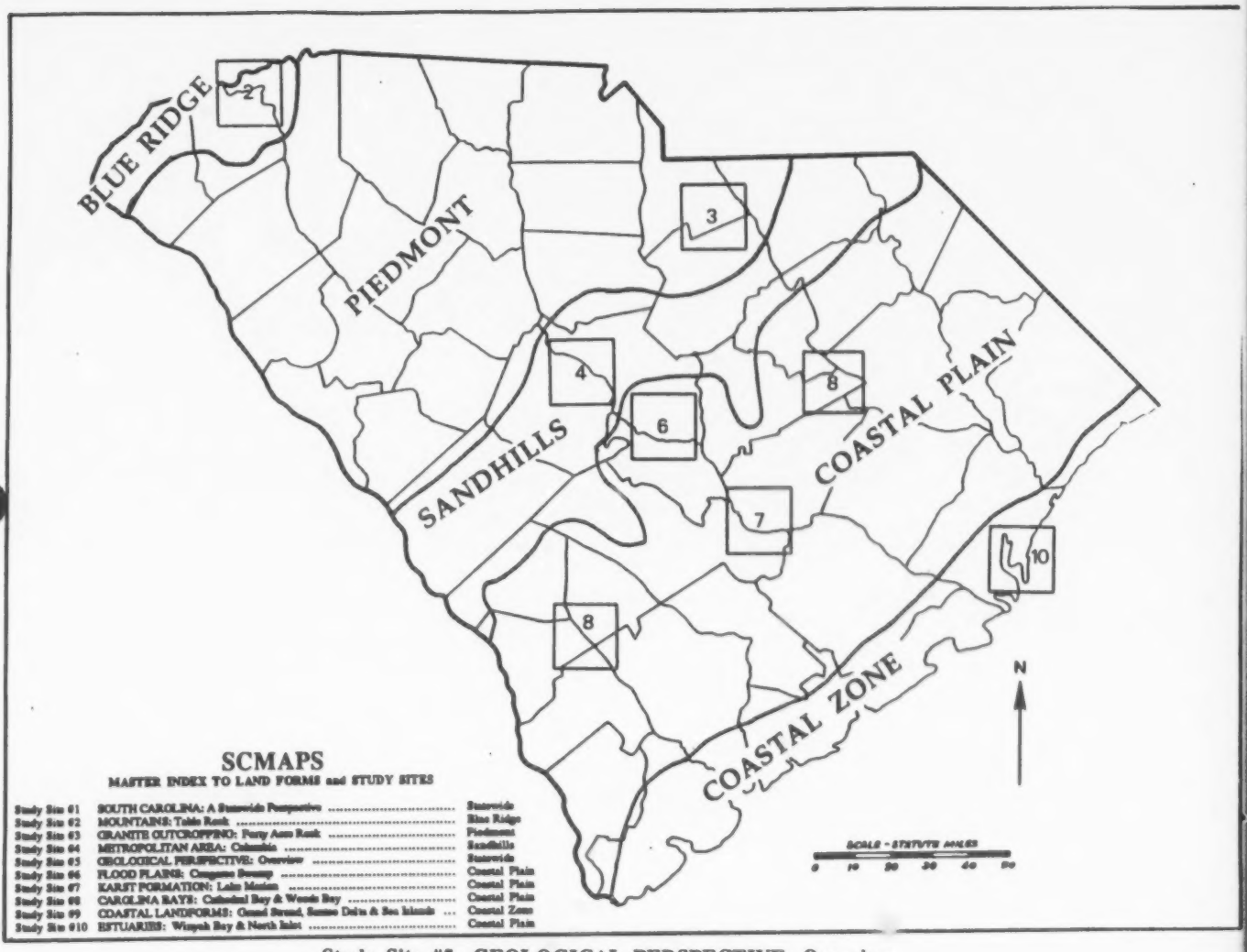
BLUE RIDGE
PIEDMONT
SANDHILLS
COASTAL PLAIN
COASTAL ZONE
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SCMAPS
MASTER INDEX TO LAND FORMS and STUDY SITES
Study Site #1 SOUTH CAROLINA: A Statewide Perspective ..... Statewide
Study Site #2 MOUNTAINS: Table Rock ..... Blue Ridge
Study Site #3 GRANITE OUTCROPPING: Pony Arm Rock ..... Piedmont
Study Site #4 METROPOLITAN AREA: Columbia ..... Sandhills
Study Site #5 GEOLOGICAL PERSPECTIVE: Overview ..... Statewide
Study Site #6 FLOOD PLAINS: Congaree Swamp ..... Coastal Plain
Study Site #7 KARST FORMATION: Lake Marion ..... Coastal Plain
Study Site #8 CAROLINA BAYS: Cathedral Bay & Woods Bay ..... Coastal Plain
Study Site #9 COASTAL LANDFORMS: Grand Strand, Santee Delta & Sea Islands ... Coastal Zone
Study Site #10 ESTUARIES: Winyah Bay & North Inlet ..... Coastal Plain

Study Site #5 GEOLOGICAL PERSPECTIVE: Overview

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COASTAL PLAIN

STUDY SITE #5

GEOLOGICAL PERSPECTIVE: OVERVIEW

POWER THINKING

Lake Marion and Lake Moultrie are two large reservoirs in the Coastal Plain. If you had to construct two new reservoirs in the Coastal Plain, where would you place them? What areas of the coast would these new reservoirs affect? How would they affect the area where they were placed? Use either one of the State of South Carolina Base Maps.

RATIONALE

The Coastal Plain landform region is the largest geographic division in the state. Stretching from the Sandhills to the Atlantic Ocean, it comprises nearly two-thirds of South Carolina's total land area. Having by far the most productive soil of any region in South Carolina, the Coastal Plain has consistently been a major agricultural region as well as a valuable resource for the timber industry. As would be expected with this predominant land use, the region is very sparsely populated compared to the Piedmont, Sandhills/Midlands, or Coastal Zone. Several unique landform types are found in this diverse area and are illustrated by the three different study sites. Study Site 6, Flood Plains: Congaree Swamp illustrates a typical hardwood river bottom forest environment found along many Coastal Plain rivers. Study Site 7, Karst Formation: Lake Marion shows the development of karst sinkhole topography due to underlying limestone rock. Study Site 8, Carolina Bays: Cathedral Bay and Woods Bay give examples of the unique landform known as Carolina bays that have puzzling origins. This study site will focus on the general history of the coastal plain including natural areas, early railroads, and crop production areas.

INSTRUCTIONAL OBJECTIVES

1. Recognize diverse landform types by structural features, shape, drainage patterns, and other indicators on maps and photographs.

2. Recognize different vegetation patterns found in the flood plains, savannahs, Carolina bays and areas of higher elevation.

3. Determine how unwise practices can affect the ecological balance of our natural resources including forests, soil, and wildlife.

4. Recognize the diversity of wildlife refuges in the Coastal Plain region preserved for recreation and wildlife habitat protection.

5. Develop an awareness of the early pioneering efforts made by South Carolinians in railroad transportation.

MATERIALS

1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Base Map, Shaded Relief	1:500,000
1	Land Use/Land Cover Map by Watershed (Back cover)	
6	General Soil Map, South Carolina	1:750,000
1	South-Carolina Rail-Road, Bill of Fare for Best Friend (insert)	Study Site 5-7,8

BACKGROUND INFORMATION

Coastal Plain Once an Ocean Floor

The **Coastal Plain** has been subdivided in a number of different ways. Most people make a clear distinction between the **Upper (or Inner) Coastal Plain** and the **Lower (or Outer) Plain**. The **Orangeburg Scarp (Citronelle Escarpment)** running through Shaw Air Force Base marks the boundary between the two divisions and probably represents an old cliff or sea-wall associated with the temporary shoreline of a larger and deeper Atlantic Ocean approximately **20 to 30 million years ago**.

The **Upper Coastal Plain** in many ways resembles parts of the Piedmont and Sandhills/Midlands as the topography is hilly varying only slightly in elevation from 300 feet near the Sandhills to about 220 feet at the Orangeburg Scarp. The much flatter and almost featureless **Lower Coastal Plain** slopes gradually towards the ocean in a series of steps or terraces which represent other temporary shoreline positions throughout geologic time.

Both divisions are underlain by marine sedimentary rock representing nearly horizontal deposits of mud, silt, and limestone which have experienced later compaction and cementation. Although the area is now above sea level, allowing erosion to take place, the large amount of land occupied by the floodplains of both major and minor rivers makes the region primarily a depositional area. As such, the soils, particularly at lower elevations, are of excellent quality and are primarily responsible for the area becoming a major agricultural region. In the very lowest areas, drainage can become a problem, making such areas unsuitable for regular agricultural use but very favorable for the growth of floodplain forests.

All Coastal Plain sediments were originally deposited long ago when the sea level was much higher than its present position. Most marine sediments were deposited on top of an older surface of igneous and metamorphic rocks of the same type as are exposed in the Piedmont. Because this erosion surface slopes gradually seaward, the Coastal Plain sediments are much thicker near the coast (over 3,000 feet thick), but thin to practically nothing near the Fall Line. Deeper water sediments are found closer to the present coast while more terrestrial types of deposition are found closer to the Fall Line.

The **accumulation of Coastal Plain sedimentary layers began** with a major sea level increase some **80 million years ago during the Cretaceous Period**. With very few exceptions, deposition continued uniformly until the **Quaternary Period**. Most of the **terraces found on the Lower Coastal Plain** are thought to be related to sea-level rises during the **Pleistocene Ice Ages**. Although ice itself did not reach as far as South Carolina, expansion and retreat of continental glaciers alternately lowered and raised sea level as ice formed and then melted. **The terraces and associated escarpments represent interglacial ages of higher sea level** when features such as marshes, deltas, beaches and barrier islands formed far inland from the modern ocean. Although erosion has modified these features, sometimes considerably, they can often be recognized by their distinctive soil types. Several **river paths in South Carolina appear to have been diverted by old terrace** features, examples of these include the Black, Edisto, and Lynches. Modern deposition, due to a relatively stable sea level, is essentially limited to sediments from flowing water called alluvial deposits.

Natural Areas

Several parks, preserves, and wildlife refuges in the Coastal Plain region serve to highlight unique environments as well as to protect rare or endangered plant and animal species. When colonists first arrived in South Carolina, millions of acres of bottomland hardwood forest existed within the state. Today, the natural habitat is measured in thousands of acres and even that amount is under increasing pressure from timber and agricultural interests for development. In addition to the Congaree Swamp study site, other protected areas include the **Webb Wildlife Center** in Hampton County, **Savannah National Wildlife Refuge** in Jasper County, **Wambaw Creek Wilderness Area** in Berkeley and Charleston Counties, and the **Francis Beidler Forest** located in Four Holes Swamp, Dorchester County. The last two of these wilderness areas highlight swamp regions which have become protected from increasing pressures, a last refuge for a host of endangered plants and animals. All of these areas serve as reminders of the **Coastal Plain's greatest resources: extensive forests, fertile soil, and abundant wildlife.**

Historical Overview

Early settlers preferred the Upper Coastal Plain region over most of the low country for practical reasons such as better drained agricultural land, tillable soil, and accessibility to rivers for transportation of supplies. It was also because of their perception that swamp areas were unhealthy environments. Even those families with plantations in the low country spent most of their time on coastal beaches, such as Pawleys Island, or at inland settlements like Summerville.

By the early 1700s, however, much of the low country's landscape had been altered by clearing and **diking** marshes and river swamps **for planting rice** and by draining other inland swamps for agricultural production. Such activity interrupted the natural flood-control system provided by the wetlands and ultimately made necessary the new system of dams, lakes, and other artificial structures which have been built for modern flood control. Other areas higher in elevation such as grasslands or **savannahs** were cleared, planted, and maintained by periodic controlled burning.

Later, in the 19th century, the **timber industry began to discover the potential resources** of the Coastal Plain region and started to harvest vast acreages of southern pines and swamp hardwoods. **The two most valuable trees turned out to be the longleaf pine and the cypress.** The orderly plantings of seemingly endless miles of pine trees along highways to the coast are a living testimony to the activities of forestry management. Fortunately for us, some forested areas were too wet for farming and too difficult for logging. These have been handed down as rare remnants of the wilderness forest typically encountered by South Carolina's earliest inhabitants.

Although **sand and gravel constitute the major mineral resources of the Coastal Plain**, two others need to be mentioned. **Phosphate** deposits occur in areas near the coast. Although no longer mined commercially, this mineral, used for fertilizer, provided in the 1800s an economically important resource for the region. Today, **limestone is mined in Dorchester, Orangeburg, and Berkeley counties** and is used mainly in concrete which is a mixture of crushed limestone, sand, and cement.

While long protected by inaccessibility and its sheer size, the Coastal Plain region is rapidly being transformed into prime agricultural and timber land, activities which will continue to be quite successful in the region. Unfortunately, in the process of draining swamps, clearing land for fields, and opening up larger areas to lumbering, wildlife habitat has decreased dramatically. While some preserves have been established to provide sanctuary for wildlife as well as to protect unique and unusual environments, **continued conservation is essential if the many resources of the Coastal Plain are to be preserved intact for future generations.**

Early Railroads Become An Important Transportation Link

The transportation system through South Carolina in the early 1800s needed great improvement. Charleston was the center of trade. It was thought that canals would make the rivers more accessible to the farmers for commerce, however, the canal system proved to be impractical and unprofitable. **Farmers in the up country needed a means of transportation in order to get their products to Charleston and the merchants needed more trade.** It was easier to go from Philadelphia to Charleston than to go from Greenville to Charleston. **A solution was to build a railroad that would provide transportation to the port city.**

The **first railroad** was built by private investors from Charleston to Hamburg, which is located on the Savannah River in North Augusta. The following excerpt describes the first trip made by **The Best Friend of Charleston**. It is taken from a resource guide accompanying American Spirit.

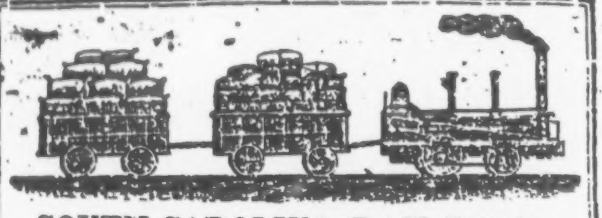
> *....On the wings of the wind at the speed of fifteen to twenty-five miles an hour annihilating time and space and leaving all the world behind." That's the way one passenger described the inaugural trip of "The Best Friend of Charleston" on Christmas Day, 1830. This inaugural run culminated three years of planning and building by the South Carolina Canal and Railroad Company. It had been chartered by a group of Charleston businessmen to help the financially troubled port in their city. Their aim was to build a transportation system to facilitate the carrying of goods from the western interior of South Carolina to the port of Charleston rather than to its rapidly growing rival, Savannah. The locomotive for "The Best Friend of Charleston" was build at West Point, New York and brought to Charleston by ship. It was the first locomotive built in America for regular passenger service. In 1833 when its 136 mile track was completed to Hamburg (across the Savannah river from August, Georgia), it was the longest railroad in the world. Six months after its first run a fireman on the "Best Friend," annoyed by the hissing of steam escaping from the boiler safety valve, proceeded to hold down the valve. The resulting explosion killed the fireman and blew the locomotive boiler into many pieces. The "Best Friend" was replaced by another locomotive the "Phoenix." Each September the "Railroad Daze" festival is held in Branchville in Orangeburg County. Branchville is located where a line to Columbia and Camden "branched" off of the main railroad line. A scale replica of the "Best Friend" was built by the Southern Railway Company in 1928 to celebrate the 100th anniversary of the South Carolina Canal and Railroad Company.*

Today, the replica of **The Best Friend of Charleston** is permanently housed in the South Carolina State Museum. As railroad lines were added to crisscross South Carolina, many towns sprang up at junction points. These early railroads provided an important transportation link for farmers to market their products, phosphate to be shipped as fertilizer, and timber to be logged and harvested. An advertisement that appeared in Miller's Almanac (insert) describes arrival and departure time, charges, freight rates, and regulations for both the passengers and freight of the **Best Friend**. It is inserted for comparison with current day transportation in South Carolina.

Summary

The Coastal Plain landform comprises the largest geographical division in South Carolina. Geologically, 20 to 30 million years ago it was covered by waters of the Atlantic Ocean. The deposition of materials from the Piedmont and Blue Ridge regions formed a diversity of landforms. The soils are of excellent quality and form the major agriculture belt of the state, while several river systems draining the state form flood plain swamp areas which contain abundant hardwood forests and wildlife. The need to get produce to the market in Charleston, the flat topography of this region, and the slow moving meandering rivers were factors contributing to the pioneering efforts made towards early railroad transportation.

Now there are concerns that prime farm land is disappearing to developers, timber land is being cut at alarming rates, and wildlife habitat is decreasing dramatically. Even with the large number of national and state wildlife preserves, the public must become aware of proper conservation practices so that the ecological balance is not disturbed and future generations can enjoy these unique environments and productive farm land.



SOUTH-CAROLINA RAIL-ROAD,

Between Charleston and Hamburg, S. C. opposite Augusta, (Geo.)

Distance 136 miles, performed in daylight, from 6 A. M. to 6 P. M. *President*, John Ravenel. *Directors*—Wm Aiken, A. Black, Wm. Bell, J. J. Bulow, Dr. S. H. Dickson, John Dixon, H. F. Faber, John Haslett, B. J. Howland, Dr. Joseph Johnson, T. Tupper. *Auditor*, Henry Ravenel. *Secretary*, J T Robertson, *Principal Engineer*, H. Allen.

RATES OF PASSAGE.

From Charleston to	Miles	$	Cts.	From Hamburg to	Miles	$	Cts.
Woodstock,	15		50	Aiken,	16		75
Summerville,	21		75	Blackville,	46	2	25
Inabnet's,	32½	1	62½	Midway,	64	3	25
Branchville,	62	3	00	Branchville,	74	3	75
Midway,	72	3	50	Inabnet's,	103½	5	12½
Blackville,	90	4	50	Summerville,	115	6	00
Aiken,	120	6	00	Woodstock,	121	6	25
Hamburg,	136	6	75	Charleston,	136	6	75

And from one intermediate Station to *another*, FIVE CENTS per MILE. *Children under 12 years and Coloured Persons, half-price.*

Regulations for the Passenger Carriage.

1st. All baggage at owner's risk—75 lbs. allowed. 2d. servants tho not admitted, unless having the care of children, without the consent of all the Passengers. 3d. Passengers not allowed to stand on the outside platform. 4th. moking prohibited, 5th. No Gun or Fowling Piece shall be permitted to enter the Car unless examined by the Conductor. 6th. The feet not to be put on the Cushions, nor the Cars soiled, defaced or injured in any way. 7th. Dogs not admitted into the Passenger Cars. 8th. At the ringing of the Bell, Passengers will be allowed one minute to take their places. 9th. Seats must be engaged and paid for fifteen minutes previous to the hour of departure. As a general direction, the conductors of the Carriages are instructed not to permit any conduct that is inconsistent with good order, or the comfort and safety of the Passengers: for which especial end these Rules have been established, and are required to be enforced with civility but strictly.

HOURS OF DEPARTURE AND ARRIVAL.

UPWARD PASSAGE.

LEAVE CHARLESTON, at 6 A. M.

To Woodstock, running time and stoppages 1h. 5m.

Not to arrive before 5m. *past* 7 *A. M.*—Breakfast 20 minutes.

From Miller's Planters and Merchants Almanac, Charleston, 1835

Leave Woodstock at half past 7 A. M.
To Branchville, running time and stoppages 3h. 30
Not to arrive before ½ past 10 *A. M.*
Leave Branchville, 11 A. M.
To Blackville, running time and stoppages 2h. 20m.
Not to arrive before ½ past 1 *P. M.*—For Dinner 25 minutes.
Leave Blackville, at quarter before 2 P. M.
To Aiken, running time and stoppages 2h. 15m.
Not to arrive before ½ past 3 *P. M.*
Leave Aiken, at 4 P. M.
To Hamburg, running time and stoppages 1h. 10m.
Not to arrive before ½ past 5 *P. M.*—20m. for Plane & starting.

DOWNWARD PASSAGE.

Leave Hamburg, at 6 A. M.
To foot of Plane, running time and stoppages 1h. 10m.
Not to arrive before 7 *A. M.*—Up the Plane 20m.—Breakfast 20m.
Leave Aiken, at 8 A. M.
To Blackville, running time and stoppages 2h. 15m.
Not to arrive before 10 *A. M.*
Leave Blackville, quarter past 10 A. M.
To Branchville, running time and stoppages 2h. 15m.
Not to arrive before ½ past 12 *M.*
Leave Branchville, at half past 11 M.
To Summerville, running time and stoppages 3h.
Not to arrive before ½ past 3 *P. M.*—Dinner 25 minutes.
Leave Summerville, at 4 P. M.
To Charleston, running time and stoppages 1h. 30m.
Not to arrive before ½ past 5 *P. M*

RATES OF FREIGHT.

	Per foot	Per 100lbs.		Per foot	Per 100lb
To Branchville,	7 cents	25 cents.	To Aiken,	23 "	45 "
Midway,	8 "	28 "	Hamburg,	14 "	50 "
Blackville,	10 "	25 "			

The above embraces *all* charges, (including Insurance from Fire while travelling) and one week's *Storage.*

CHARGES.

For labbor and storage (not exceeding one week) 3½ cents per hundred pounds, or 1 cent per cubic foot. After which storage to be charged at Charleston rates.

N. B.—Hollow Ware not taken loose. Demijons, Jugs, and every description of Glass or Earthen Ware, not securely packed, to be at the owner's risk.

REGULATIONS.

1st. Freight will be forwarded agreeably to the order of time it is received. That intended for the morning trip must be at the Depository by two o'clock the day previous, in *good order, and marked the name of the station on the line it is to be left at, or it will not be received.*

2d. Freight for Jerico and the other stations up to, and including Reeves', is payable at the Charleston Depository, and to be left at the place directed, at the risk of the owner.

3d. All freight must be paid for at the respective Depositories on its *delivery.*

4th. No package of any description, for any of the stations, entered on the freight list for less than 12½ cents, and no receipt given for a less amount of freight than 50 cents. 5th. GUNPOWDER prohibited.

From Miller's Planters and Merchants Almanac, Charleston, 1835

COASTAL PLAIN 5-8

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INSTRUCTIONAL STRATEGIES

ACTIVITY A RAILROADS MADE EXTENSIVE FORESTS AND FERTILE SOIL ACCESSIBLE

Materials

1	State of South Carolina Base Map	1:500,000
1	Land Cover/Land Use Map by Watershed (back cover)	
1	South-Carolina Rail-Road, Bill of Fare for Best Friend (insert)	Study Site 5-7,8
	Tracing Paper	

Activities

1. Look at the State Land Use/Land Cover Map. Which land use is concentrated around rivers and streams? Which land use dominates the Upper Coastal Plain? Which land use dominates the Lower Coastal Plain?

2. Using the Land Use/Land Cover Map, identify and name the river bottom flood plain areas. Name the reservoirs, five river drainage systems, and major urban areas in the Coastal Plain region.

3. Locate Aiken County on the State of South Carolina Base Map. This county is mostly in the Coastal Plain region and shows the typical drainage pattern. Place a piece of tracing paper over Aiken County and outline the stream drainage pattern of the South Fork Edisto River and its tributaries. The resulting branching (dendritic) pattern is typical of flat landscape.

4. Now locate Williamsburg and Georgetown counties. On another piece of tracing paper, trace the drainage pattern of Black River and its tributaries. Note the sharp bend in the Black River in Georgetown County. This deflection marks the location of a former marine terrace which has diverted the normal drainage. Using drainage patterns as your key, locate other terraces or escarpments in Dorchester and Florence counties.

5. Locate Barnwell and Marion counties. Note that these two counties are approximately the same size. Look at the amount of swamp land in each county. Which county has the most swampland? Why?

6. Locate the following natural sites and explain how each area represents a unique resource of the Coastal Plain.

   Congaree Swamp National Monument, Richland County
   Webb Wildlife Center, Hampton County
   Savannah National Wildlife Refuge, Jasper County
   Wambaw Creek Wilderness Area, Berkeley and Charleston Counties
   Francis Beidler Forest, Four Holes Swamp, Dorchester County
   Cathedral Bay Heritage Preserve, Bamberg County
   Santee National Wildlife Refuge, Clarendon County

7. Use the advertisement that appeared in Miller's Almanac to trace the route of **The Best Friend of Charleston** from Charleston to Hamburg. Identify the rivers and swamps that had to be crossed. How long was the journey? Is there a railroad running along this same route today? How much was the fare one way? How have the regulations changed? What is a Demijons? Why would gunpowder be prohibited?

ENRICHMENT ACTIVITIES

1. Find out how Eli Whitney's invention of the cotton gin provided South Carolina with a new staple crop, often referred to as King Cotton.

2. Where is the closest railroad to your school? How often does it run? Is it mainly a freight or passenger line? What type of freight is carried on this line? Where are the passengers headed?

3. In **South Carolina: The Making of a Landscape**, railroad lines existing in 1925 are illustrated on page 120. Identify the major railroad junction points in South Carolina. Have these changed much? Explain. Which junction point is nearest your school?

ACTIVITY B SOILS OF THE COASTAL PLAINS

Materials

6	General Soil Map, South Carolina	1:750,000
30	South Carolina's Land Resources: A Regional Overview	

Activities

1. Review the five previously identified landform regions on the General Soil Map. Compare the differences in soil erosion potential between the Piedmont, Sandhills, and Coastal plain landscape.

2. Compare the soils of the Piedmont, Sandhills, and Coastal Plain. How has soil affected the vegetation and land use of each region?

3. Identify the counties in the Coastal Plain region that comprise the crop belt of South Carolina: Aiken, Allendale, Bamberg, Barnwell, Calhoun, Chesterfield, Clarendon, Darlington, Dillon, Florence, Kershaw, Lee, Marion, Marlboro, Orangeburg, and Sumter. Describe the soils found in these counties. Relate the crop belt area to the landform regions of South Carolina.

ENRICHMENT ACTIVITIES

1. Investigate the major components of fertilizer. Why is fertilizer needed? What is meant by the sequence of numbers, 5-10-15, found on the fertilizer bag? How is each unit used by the plants? When is fertilizer needed?

2. Using a soil testing kit available at local feed and seed stores, analyze the soil in your school grounds to determine the major nutrients or lack of nutrients needed for green foliage plants.

3. Determine from your local County Extension Office, the amount of the cash crops sold in South Carolina such as tobacco, cotton, corn, and soybeans. Which is the largest cash crop? Are there other cash crops sold? If so, what are these?

PLACES TO VISIT

- Plan a visit to one of the wildlife refuges mentioned in this study site. Most of these centers have educational programs designed for student groups if prior arrangements are made.

Congaree Swamp National Monument	(803)776-4396 or 765-5571
Webb Wildlife Center	(803)625-3569
Savannah National Wildlife Refuge	(912)944-4415
Wambaw Creek Wilderness Area Francis Marion National Forest	(803)336-3248 or 887-3311
Francis Beidler Forest, Four Hole Swamp, Audubon Society	(803)462-2150
Cathedral Bay Heritage Preserve	(803)734-3893
Santee National Wildlife Refuge	(803)478-2217

- The Railroad Museum located in Branchville, SC contains artifacts from the early railroad days of South Carolina. Visits can be arranged as the museum is open daily.

- Visit a cotton gin in the fall, tobacco market in August or September, soybean farm during harvesting time in the fall, or dairy farm at milking time.

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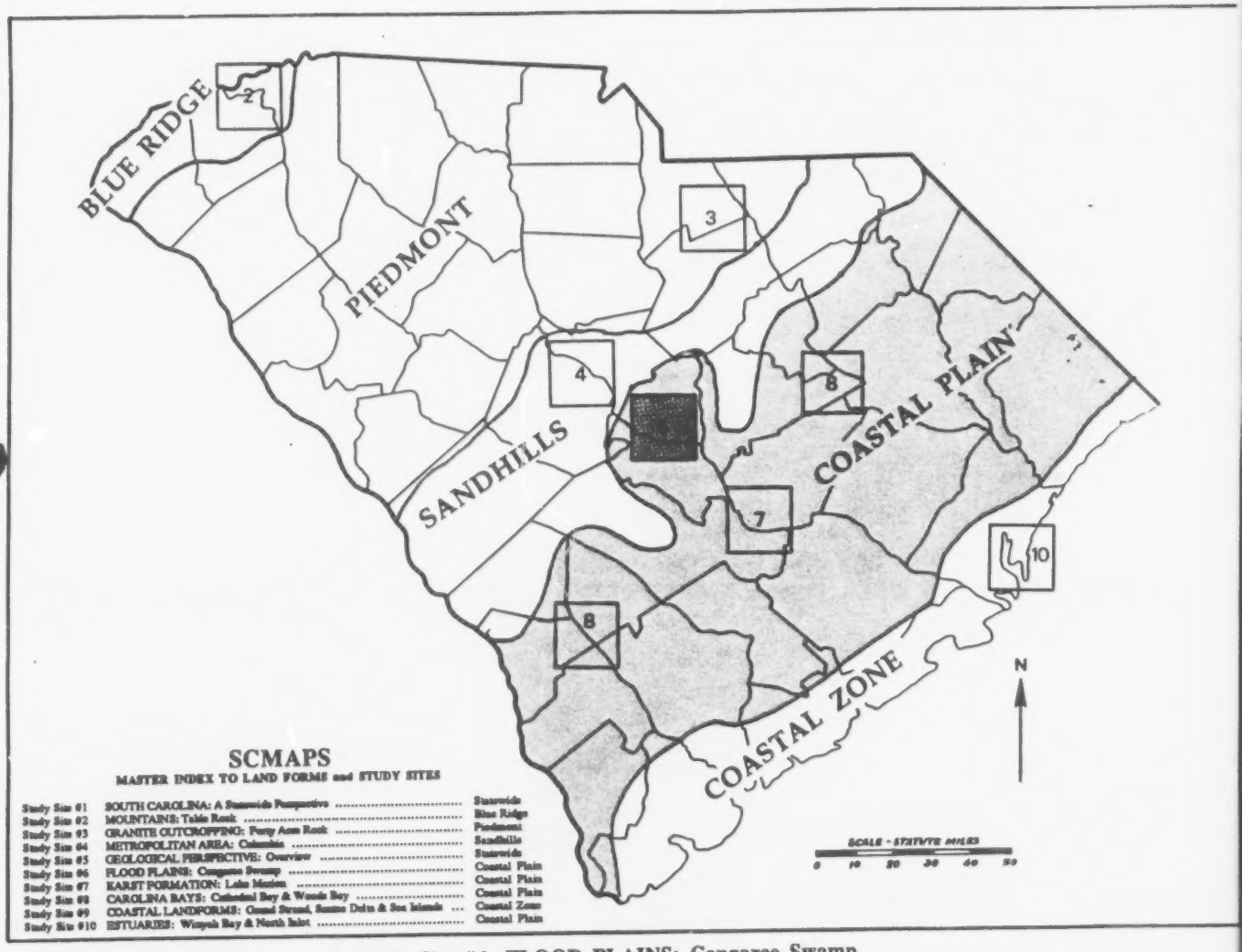
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PIEDMONT
SANDHILLS
COASTAL PLAIN
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SCALE - STATUTE MILES
0 10 20 30 40 50

Study Site #6 FLOOD PLAINS: Congaree Swamp

COASTAL PLAIN

STUDY SITE 6

FLOOD PLAINS: CONGAREE SWAMP

POWER THINKING

Suppose you are a "black bear" looking for food and you have the Gadsden, SC USGS Topographic Map. You know there are some trash cans that you can raid at Gadsden School, however, you are on the highest bluff on the South side of the Congaree River. To get to the school yard you must swim across the river and make your way through the swamp. How many creeks do you have to swim across before reaching the school yard? How many miles is this? What are some of the other animals that you might encounter on this trip through the swamp? What types of vegetation will you see? What kind of food might you find on the way?

RATIONALE

Bottom land swamps are found along the old meandering rivers draining the coastal plain. These relatively flat flood plain areas are havens for fishermen, hunters, and naturalists. River bottom swamps not only provide excellent habitat for wildlife but also serve several ecological functions such as flood control, ground water recharge, and pollution filtration. A recent environmental concern is the alarming rate at which these areas have been converted to agricultural as well as commercial and residential developments, along with the possibility of contaminants entering the swamp through the Congaree River.

INSTRUCTIONAL OBJECTIVES

1. Outline the physical characteristics of a Carolina flood plain swamp including the types of vegetative growth and animal life.
2. Analyze the ecological functions of a river bottom flood plain.
3. Identify the major flood plain swamps in South Carolina.
4. Explain the process of oxbow lake formation by a meandering river.

MATERIALS

1	NAPP Transparency Congaree Flood plain	1: 40,000
1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Base Map, Relief Map	1:500,000
6	Gadsden, SC USGS Topographic Maps	1: 24,000
1	Package Tracing Paper	

BACKGROUND INFORMATION

Carolina Bottom Land Swamps

Carolina swamps are too wet to farm and until recently have been unprofitable as a source of timber. Yet, these river bottom swamplands have intrigued settlers from the beginning. Both **Francis Marion, nicknamed the "Swamp Fox,"** and **Thomas Sumter, the "Gamecock,"** eluded the British troops during the American Revolution with hit and run tactics by using their familiarity with the swamps. In this study, only the flood plain river bottom swamps will be explored while the isolated swampy areas referred to as Carolina Bays will be covered in a later study site.

Once considered only as a breeding ground for mosquitos and snakes, the mighty **Carolina wetlands** are now considered to be **one of the state's most precious natural resources**. Today, as in the past, the Carolina swamps provide an excellent recreational environment, a unique ecological function, and an abundant source for hardwood timber. Alligators, wild boars, water moccasins, black bears, bob cats, and barred owls are just a few of the wildlife inhabitants that depend on this river bottom forest for survival, making the Carolina swamps a unique area for both sportsmen and naturalists.

In addition to wildlife habitat, the **Carolina wetlands** are a landform feature that is known to **provide** other **important ecological functions** among which are flood control, ground water recharge, and pollution filtration. In seasons of heavy rain fall, approximately ten times a year, the swamps provide a wide flat area to accommodate water swelling over the banks of the rivers. By slowing the water down, a greater percentage of floodwater is able to soak into the ground, raising the water table. Also as the water slowly flows through the meandering rivers to the ocean, sediment is deposited along the way.

The Carolina swamps are an important source of cypress and hardwood timber once too difficult to harvest. Now with modern harvesting equipment, lumbering is increasingly profitable. A recent concern is that harvesting of lumber is taking place at too fast a rate in some areas of the state, particularly in old growth stands.

Congaree Swamp

The **Congaree Swamp** represents an example of one of South Carolina's most intriguing and mystifying natural environments. The **Congaree Swamp is a typical Coastal Plain bottomland swamp** and is used as an example to study all of the Carolina flood plain forests. These include the swamps found along the Wateree, Santee, Pee Dee, Little Pee Dee, Lynches, Black, Cooper, Edisto, Salkehatchie, Coosawatchie, and Savannah Rivers. The Congaree Swamp is an undisturbed mature forested flood plain situated on the Congaree River. The 15,000 acre Congaree Swamp is considered the largest and best example of a mature forested flood plain in the United States. One of the last sightings of the now extinct "Ivory-billed" woodpecker, that once flourished in the deep swamps, occurred in the Congaree Swamp.

In 1976, a portion of the **Congaree Swamp** was declared a national treasure when the United States Congress purchased the 15,000 acre tract. At that time, the **Congaree Swamp National Monument** became part of the National Park Service. As stated in the document, the tract was purchased:

> *In order to preserve and protect for education, inspiration, and enjoyment of present and future generations an outstanding example of a near virgin Southern Hardwood forest.*

Our generation and generations to come can be grateful for those who saw more in the majestic Congaree forest than so many board-feet of lumber. They saw a legacy of nature which, once destroyed, could never again be replaced. One of these vision-minded men was Francis Beidler, a rare kind of lumberman and conservationist whose family owned the property which is now the **Congaree Swamp National Monument**. Mr. Beidler, recognizing the pressures forests were facing from exploitation in the early 1900s, instructed his heirs that certain unique forests should be preserved as a vital national asset. Another swamp in South Carolina that bears the name of this outstanding conservationist is the Audubon Society's Beidler Forest in Four Holes Swamp in Dorchester County.

The **Congaree Swamp** represents the **Redwoods of the East**, boasting a forest of record size trees found nowhere else in the United States. Of the 85 types of different tree species, seven are known to be **National Record Trees**, the largest of their kind in the entire country, while 16 others reign as **South Carolina State Champions**. Comprised mostly of deciduous hardwood species, these record trees required many years of growth to arrive at their champion sizes. Some are around 600 years old. As the river swells during flood periods, especially in February, the river waters top the river banks and flood the bottomland forests with muddy water laden with rich topsoil washed from farmland upstream. As the waters recede, the silt and mud is left behind. The result is a very productive landscape for producing magnificent forests and their associated ecosystems.

In geologic terms, the Congaree flood plain has evolved over millions of years. The physical forces associated with the river meandering its way to the ocean, depositing sediments and eroding bluffs, are a never-ending process. The great volume of floodwater in the Congaree River, especially before the construction of major reservoirs upstream greatly enriched the soil in organic matter and nutrients. Since the building of dams, less and less sediment has been supplied to the floodplains of the Congaree River. Eventually, this lack of new sediment will result in lower fertility levels for bottom land soils.

Oxbow Lakes

As the mighty Congaree River, and likewise other meandering coastal plain rivers such as the Great Pee Dee, the Savannah, and the Wateree, works its way through its flood plain, oxbow lakes are often formed. By the time these rivers have flowed through the Piedmont to the Coastal Plain areas of South Carolina, the speed of the river has slowed down considerably. This is due to the reduction in slope of the land. Coastal plain rivers are often called **lazy or meandering rivers** because they weave their way to the ocean forming curves and loops. The rivers flow from side to side wearing away the outside of the curve and depositing sediment on the inside of the curve. River currents flow faster on the outside of the curve compared to the inside. This is just like race drivers who must drive their cars faster around the outside of a track to keep up with the cars on the inside. Material is eroded from the outside of the curve where the water is going faster and deposited on the inside of the curve where the water is flowing slower. Thus the curve or "U" is continually made even greater. Eventually **during high water, the river may swell and flood over the banks cutting a new straight channel** at the base of the "U" and **leaving behind a crescent shaped body of water** called an **oxbow lake**. These lakes make excellent habitat for water fowl.

This geological process permits the widening of the flood plain as new channels form and cut more deeply into the adjacent bluffs. The Congaree Swamp, along with many other **flood plain areas in South Carolina, has produced many old oxbow lakes.** A number of these lakes are located a considerable distance from the present day river. Many of the older **oxbows** have partially filled in with sediments and are now grown over with trees. Such areas are extremely wet and contain species such as the bald cypress and water tupelo. On the higher bluffs of the flood plain, black and sweet gums, dispersed pines, and various oaks dominate the forest. The high bluffs overlooking the Congaree flood plain are comprised of pine and hardwood mixed forests.

Summary

By the time South Carolina rivers have reached the relatively flat Coastal Plain Region, the flow of the rivers has slowed down considerably. From there on these rivers are meandering their way to the ocean flanked on each side by floodplains. These swampy areas serve an ecological function of flood control that accommodates heavy rain fall and allows water to soak back into the ground recharging the water table. **Congaree National Wildlife Monument** was selected for this study site because it serves as a typical example of the many bottom land swamps found in the Coastal Plain of South Carolina. It also serves as a reminder that we must prevent excessive logging and protect against contaminants entering one of our State's most precious natural resources, the Carolina bottom land swamps.

ACTIVITY A **CONGAREE SWAMP**

Materials

1	NAPP Transparence Congaree Swamp	1: 40,000
1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina BAse Map, Shaded Relief	1:500,000
6	Gadsden SC, USGS Topographic Map	1: 24,000

Activities

1. Identify the major bottom land forest floodplains on the State of South Carolina Shaded Relief Map. Identify the five major river systems draining South Carolina. Why are most of these flood plain areas found in the Coastal Plain? Use the overlay to locate the Congaree Swamp study site on the State of South Carolina Base Map. Give a general description of the landscape of this area. The Congaree Swamp is a part of which river drainage system?

2. Using the NHAP transparency of Congaree, what evidence do you see that once upon a time the Congaree River was located in different parts of the flood plain? Why are these features called "cut-off" or oxbow lakes? Do many of them still have the crescent or "U" shape? How many distinct "oxbows" can you locate on the NHAP map? Look at the Gadsden topographic map and compare it to the oxbow lakes on the NHAP transparency. Which ones are remnants of Oxbow Lakes now covered with vegetation? Does the NHAP Transparency indicate the forest type differences? Why?

3. Using the Gadsden Topographic Map, outline the limits of the Congaree River flood plain. Use the contour lines and other symbols for guidance. Determine the high and low elevation points on the map. Describe the landforms in this area using as many descriptive words as possible. What geological processes have been responsible for producing this landscape? Describe the soil that you would expect to find in the Congaree flood plain.

4. Locate the "bluff" running along the south side of the river, pinpointing the location where the bluff touches the river. What is the elevation difference between the top of the bluff and the river? Does the top of the bluff ever get flooded by the river? Why?

5. The Congaree Swamp is named after the Congaree Indians, who used to live in this area of the swamp. We do not know much about the Congaree Indians because they disappeared before early explorers could record much about their lives. You are an archaeologist wanting to learn more about this group of Indians. Knowing that the swamp is prone to flooding, where would you begin looking for undisturbed artifacts? Where would you look for village sites? Where would you look for hunting artifacts? What would have been the fastest mode of transportation for a Congaree trader wanting to trade with a Cherokee town in the mountains?

6. Look at the present day river noting the water flow direction. In which direction is the water flowing? What evidence are you using to determine that direction? Would you expect the flow to be swift or gentle during most times of the year? Why?

7. Knowing the water flow direction, use a piece of tracing paper and "shade in" the bends of the river which are experiencing erosion and deposition action. Use two different colors to distinguish between erosion and deposition? Predict with a series of illustrations the formation of an Oxbow Lake. Explain the erosion and deposition process to your neighbor. How long do you predict that it will take for this to happen? How did you calculate the time?

8. Locate the **Congaree Swamp National Monument** and follow its boundary line noting the abundance of swampy property. Is most of this property in forests? How can you tell?

9. Locate the agricultural areas (white) in the Northern portions of the topographic map. Describe the topography of these farmland areas? What geological processes have made this particular area highly suitable for agricultural use? Describe in a short paragraph the formation of this particular soil. Where did it come from and what has helped make it naturally productive? What modern day crops are probably grown here (Note the large sizes of the fields)?

ENRICHMENT ACTIVITIES

1. The different animals of the **Congaree Swamp** have different requirements for food, shelter, and habitat areas within the swamp environment. Also, the flood plain forest is covered with water several times a year, temporarily pushing some animals out of the swamp to higher land areas, especially the deer and bears which can't live in the trees. The table below lists five different types of animals that live in the Carolina swamps. Complete the table with information about the life habits of each animal. Each one has different characteristics. They can either fly, climb, swim, or roam. One is small and one is large. Other animals could include snakes, owls, deer, raccoons, bob cats, alligators, song birds, and squirrels.

Animal Type	Habitat Types	Food Types	Animal Range	Swamp Conditions Best Suited
Bear				
Wood Duck				
Mosquitos				
Snake				
Brim				

2. At the present time, the flood plain swamps across the state are being cut at alarmingly fast rates. If the trees of the Congaree forest were all cut for timber, what effects would this have on the wildlife that lives there? How is the swamp an important aspect of the ecosystem of our wildlife habitat? What do forests provide for wildlife?

3. Locate the small town of Gadsden on the topographic map. This small community has historically been associated with its surrounding agricultural economy. Although this town is small, it is typical of hundreds of other similar agricultural regions within the Inner Coastal Plain of South Carolina. Do you suppose the railroad had any impact on the historical location and development of this community? Why? What did the railroad contribute to these communities? What other types of businesses and stores would you expect to be located in Gadsden that would support the small local farming community?

PLACES TO VISIT

- Congaree Swamp National Monument is administered by the National Park Service and offers tours and a boardwalk for viewing a typical Carolina swamp. In addition it has a variety of Record Trees and State Champion Trees. It is located in Richland County. For tours call 776-4396 or 765-5571.

- Beidler Forest is located in Four Holes Swamp, Dorchester County. It likewise has a boardwalk built over the swamp designed for ease of viewing. This natural environment has been preserved by the Audubon Society to protect endangered species of both flora and fauna. Tours are available by calling 462-2150.

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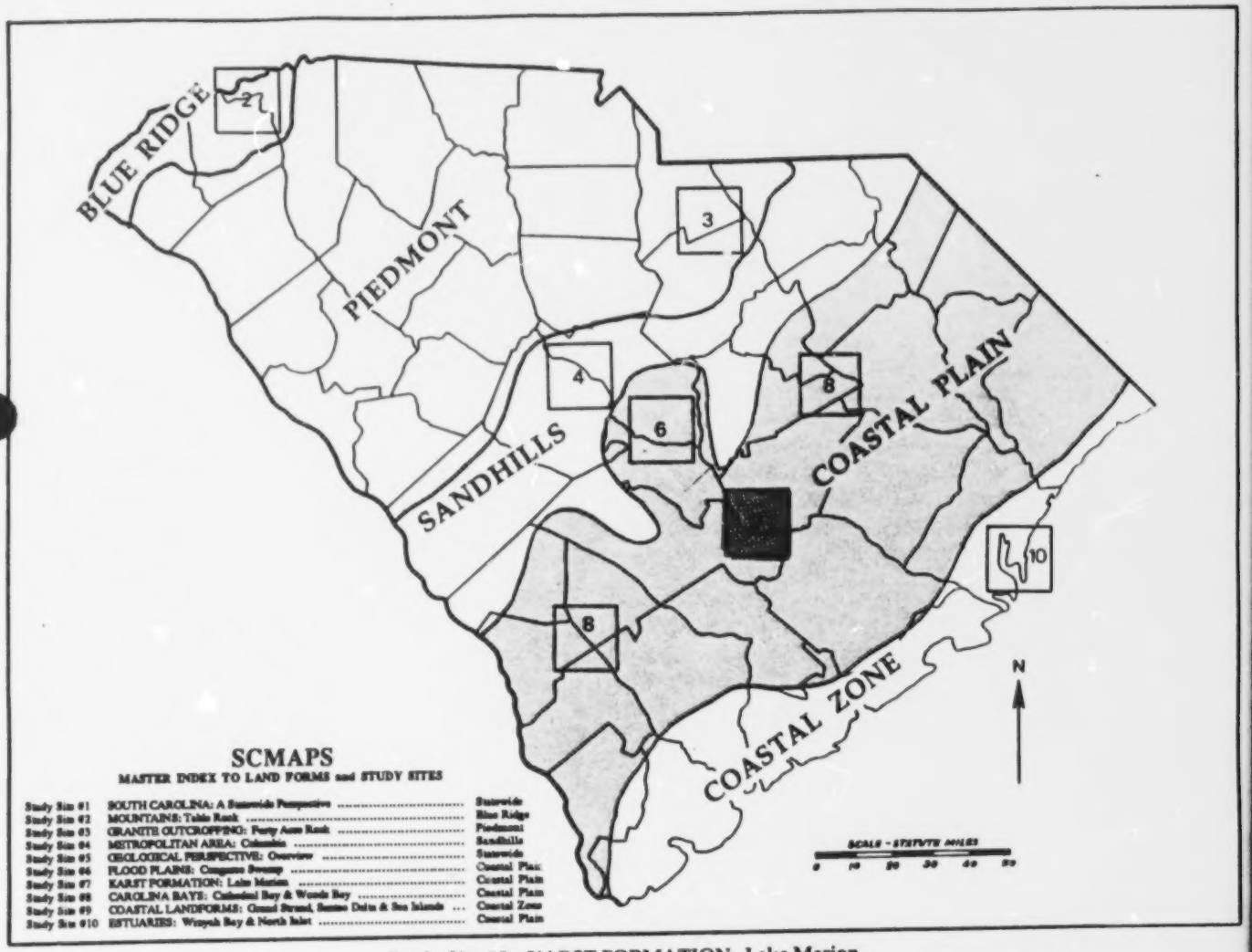
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Study Site #8 CAROLINA BAYS: Colleton Bay & Woods Bay ..... Coastal Plain
Study Site #9 COASTAL LANDFORMS: Grand Strand, Santee Delta & Sea Islands ... Coastal Zone
Study Site #10 ESTUARIES: Winyah Bay & North Inlet ..... Coastal Plain

Study Site #7 KARST FORMATION: Lake Marion

COASTAL PLAIN - Karst Formation: Lake Marion Study Site 7-1

COASTAL PLAIN

STUDY SITE 7

KARST FORMATION: LAKE MARION

POWER THINKING

Imagine you are a Yemassee Indian in 1250 A.D., on the island that will one day be Hilton Head. You want to take seashells and salt to trade to a Santee Indian town near what will someday be Lake Marion. What will be your quickest route? Explain. How far do you think the Indians could travel in a day with a loaded canoe? If they traveled 15 miles a day? Realistically do you think they could travel 15 miles a day? List three major problems that might occur on their journey. What will be their most direct route? Are these routes the same? Use the State of South Carolina Base Map with Highways.

RATIONALE

The Santee limestone is an important Coastal Plain rock formation. It is exposed at the surface only in the south-central part of the state in the Lake Marion vicinity, even though it is buried beneath other sedimentary rocks throughout a much larger area. The formation tilts gently towards the Atlantic Ocean. The Santee limestone is significant because it is the major aquifer or water producing unit for most Coastal Plain wells. Also, it represents the only major area in South Carolina where karst topography has developed. A further attraction of the Lake Marion area is the Santee National Wildlife Refuge, a wintering area for migratory birds such as Canadian geese, pintail and mallard ducks. In addition, Fort Watson, the Indian Mound that was the site of Francis Marion's skirmish with the British is in the area. These features provide the geological, environmental, and historical significance of the site.

INSTRUCTIONAL OBJECTIVES

1. Recognize limestone areas by the presence of sinkholes and other karst features on maps and photographs.

2. Assess the impact of damming the Santee River to form Lake Marion and the effect of lake levels on the Santee National Wildlife Refuge.

3. Analyze the impact of karst topography on underground water flow and supply.

4. Recognize that the water table or ground water level is approximately the same elevation as the surface water.

5. Compare different information provided by maps and photographs on both natural and man-made features.

6. Locate Fort Watson and realize why this Indian mound was the site of a Revolutionary War battle.

7. Recognize the environmental impact of depositing hazardous materials in an area which is underlain by the karst formation.

MATERIALS

1	NHAP Transparency Santee	1: 58,000
1	State of South Carolina Base Map with Highways	1:500,000
6	Vance, SC USGS Topographic Maps	1: 24,000
6	St. Paul, SC USGS Topographic Maps	1: 24,000
1	Sample of Limestone	
1	Package Hydrion test Paper	
1	Package Tracing Paper	

BACKGROUND INFORMATION

The **limestone** which **lies** exposed **along the middle portion of Lake Marion** is given the formation name, **Santee Limestone**, because it was first described near the town of Santee. This limestone is very pure and extremely porous. Most limestones are chemically produced rocks usually formed in warm, shallow ocean environments far away from sources of sand and mud which would tend to contaminate the deposit. Many animals and plants which normally live in such an environment leave behind shells or other indicators of their existence. These eventually turn into fossils within the rock. Such fossils can be used to help identify the formation.

Environmental conditions necessary for limestone deposition existed in parts of South Carolina during the Eocene Epoch about 50 million years ago. After initial deposition and burial by overlying sediment, additional calcium carbonate and magnesium carbonate are precipitated chemically from trapped groundwater to glue the rock together. Most fossils found in this limestone are marine organisms called bryozoa. These organisms form small colonies that resemble coral but are internally quite different. A **characteristic** of **Santee Limestone** is its high porosity, which is the **ability of a material to hold water**. This distinguishing feature is responsible for its being such a **good source of groundwater for the Coastal Plain region of the state**.

Karst Topography

The formation of **Karst Topography** is a very long process. It occurs because ground water is slightly acidic. Most rain is slightly acid due to absorption of carbon dioxide from the atmosphere by raindrops, and it is this rainwater which soaks into the ground to become ground water. Another reason for acidic ground water is the absorption of organic acids from plant roots and decaying vegetation. These **acids mix with water to form carbonic acid**, a weak but effective agent for slowly disintegrating rocks and soil particles. **Acidic water can therefore easily dissolve the carbonate minerals** found in limestone (recall the "acid" test for identifying the mineral calcite). As more and more minerals dissolve, the **limestone develops cracks, holes, passageways and eventually caves** allowing even more water to penetrate the rocks. In a region composed of limestone, eventually more water travels underground than on the surface and caves can grow large enough to cause roof collapse and sinkhole formation. **A region which features sinkholes, caves, and underground streams is referred to as having karst topography.** The Santee area is an excellent example of this type of activity. Karst features may not be immediately noticed on maps or photographs because only sinkholes are easily visible at the surface. Other features can only be seen from the ground and underground.

Ground Water Flow

Karst topography can influence land use patterns to some extent, but its most important effect is on ground water flow. **With so many interconnected passageways underground, it is very easy for pollution or chemical contamination** to quickly spread from one area to another. A single contamination site can affect wells and water supplies not only nearby but also in areas many miles away. Even in counties where the **Santee Limestone** is not exposed at the surface, **most wells for agriculture and home drinking water in the Coastal Plain Region are drilled into this formation**. Not only do wells in this region take advantage of the abundant supply of water stored in the pore spaces but also the high permeability or flow rates at which water can be pumped from the ground. Once pollution or contamination is introduced into this type of ground water system, it is extremely difficult to contain the pollutant or to clean it up.

Water Table

An important component of any groundwater system is the location of the **level of the underground water referred to as the water table**. This term actually refers to the boundary in rock or soil above which water only occasionally passes and does not remain. This boundary is not fixed in position but can go up or down through time depending on long-term weather patterns. For example, during times of drought, the elevation of the groundwater table would be significantly lowered. Because wells must be drilled below the groundwater table to be able to pump water, it is important to know the elevation of the ground water table so that a well can be drilled deeply enough to continue producing water even during a drought. **The elevation of the groundwater table can be measured directly in wells**, but can also be approximated **by observing water levels of lakes, swamps and other bodies of standing surface water**. We can assume that the elevation of a river bank, lake shore or swamp is a reasonable estimate of the ground water elevation in the immediate vicinity.

Santee National Wildlife Refuge

Before 1940, the Santee River flowed through this area much like any other Coastal Plain river. With the completion of the dam downstream, inundation of the floodplain began and water levels quickly rose. Timbering was not completed in time and as a result there are still portions of Lake Marion where tree trunks can be seen standing in the water. Although the original floodplain is now under water, new wetland areas formed as rising lake water encircled forests and fields and encroached on depressions in Carolina bays and in other formerly dry areas. The result has been a large diverse region containing pine, oak and hardwood forests, marsh and swamp habitat, and open-water ponds. **The refuge is best known for the flocks of ducks and geese which winter over here, generally from October to March.** In recent years, numbers of waterfowl have decreased drastically, presumably due to loss of breeding and nesting habitat in northern states and Canada but also perhaps due to acid rain effects and lead poisoning. Although management practices have not changed significantly in the Santee National Wildlife Refuge, a population decline has been observed. This serves as an early warning signal of potential environmental disaster, not just for waterfowl, but for ourselves as well.

Historical Overview

The Santee region has experienced a noticeable increase in rates of population growth and commercial development since Lake Marion was constructed. The development of Santee State Park and the opening of Interstate Highway 95 have brought increased visibility and a push toward tourism throughout this area. Several historical sites also exist locally, the most famous of which is the **Santee Indian Mound**, now part of the Santee National Wildlife Refuge. It was the site of the British Fort Watson during the Revolutionary War. In 1781, the fort was captured by the **General Francis Marion, the Swamp Fox.**

Francis Marion Captures Fort Watson

During the Revolutionary War, General Francis Marion became a hero because of the unconventional tactics he used to win battles. One of the most famous of these stories is his capture of Fort Watson, the Indian Mound, now preserved on the Santee National Wildlife Refuge. The British had established a fort on the mound by building a high wall around it as a protection for their supplies, mainly guns and ammunition. They kept it closely guarded, and the bluff surrounding Fort Watson was barren of trees. Marion and his Brigade of Southern patriots had recently been joined by General **Light Horse** Harry Lee and his Continental troops. After trying to penetrate the wall with bullets, Lee requested a cannon from General Nathanael Greene, the commander of the Southern army, in Camden. The cannon was immediately dispatched, however, Green's troops got lost and wandered around finally returning to Camden.

While Marion and Lee were waiting for the cannon, they noticed that the British were digging a well at the base of the Indian mound. Before they arrived, the water for Fort Watson had been taken from a nearby lake. Marion and his troops had cut off the British water supply. In the meantime, an epidemic of smallpox had broken out in Marion's camp. Many of the militiamen who had not been inoculated began to desert. Marion, realizing that they could not take the fort by storm, considered abandoning the siege. Major Hezekiah Maham, a Continental officer, suggested building a tower higher than the fort. Immediately, Marion sent his horsemen to scour the neighboring plantations for axes so they could chop down pine saplings. **Maham's tower** was erected during the night. At day break, the best riflemen climbed into the crow's nest to fire on the British as they went for water. The British, realizing that they could not stay there without water, raised the white flag signifying surrender. Once again Francis Marion's ragged guerrilla troops, known for eating sweet potatoes, hiding in trees, making plates out of bark, and striking at unusual times and in unusual ways had driven the British from the South Carolina swamps in a fox like manner. Thus Francis Marion was given the legendary name of the **Swamp Fox.**

Storage of Hazardous Waste Near Head Waters of Lake Marion

In an area northeast of Fort Watson near a town called Rimini is a hazardous waste landfill in close proximity (200 yards) to Lake Marion. This landfill poses a legitimate environmental concern to all South Carolinians. Not only is it a concern to the people living in communities near Lake Marion and those living down stream from the storage site, but also to all of the Coastal Plain citizens that get most of their drinking water from underground aquifers. The land near Lake Marion was originally purchased for a hazardous waste storage area because it contained larger quantities of fuller's earth. This mineral is commonly used for kitty litter because of its absorbing quality. With well over a billion pounds of hazardous waste already buried in this landfill, the fuller's earth no longer has the capacity to be used as an absorbant. Instead, a polyurethane lining with only a 50 year warranty is placed between the containers of hazardous waste and the underlying limestone rock. In time, the hazardous waste could seep through the barrier polluting the aquifer that provides water for much of the Coastal Plain Region of South Carolina. It could also enter the head waters of Lake Marion and contaminate the entire Santee River basin as it flows on down to Charleston or through the Santee Delta.

Summary

The Karst topography unique to the coastal plain is exposed in the Santee area near Lake Marion. It is the **source of underground water for much of the lower part of the state.** This natural process of acidic water dissolving the limestone coupled with the underground water transportation system could hasten a major catastrophe if contaminants were to enter the area. Recognizing and solving such environmental problems will require education of the public and cooperation of many special interest groups. Quality ground water supplies for home use and farm irrigation could easily be lost if proper conservation measures are not taken. Water quality also will have a significant impact on the Santee community including the National Santee Wildlife Refuge and Santee State Park. As recreation and tourism becomes an even greater economic resource to this region, a readily available source of ground water is a critical requirement. **The public must become aware of the special properties of limestone rock and protect such areas from pollution.** Measures must be taken so that hazardous waste is not placed in a location that could affect major underground water supplies for much of the coastal plain area of South Carolina.

Francis Marion, driven by his desire to fight for liberty for all South Carolinians, used his knowledge of the swamps to out maneuver the British troops. His siege of Fort Watson provided a historical reason for selecting this study site. The Santee River basin, now covered with the waters of Lake Marion, has become a recreational area of the state attracting many tourists. This study site is also significant because of its unusual Karst formation, with sinkholes and underground water aquifers, that provide water to much of South Carolina's Coastal Plain.

INSTRUCTIONAL STRATEGIES

ACTIVITY A KARST TOPOGRAPHY

Materials

1	NHAP Transparency of Lake Marion	1: 58,000
1	State of South Carolina Base Map with Highways	1:500,000
6	Vance, SC USGS Topographic Map	1: 24,000

Activities

1. Locate the Karst Formation: Lake Marion study site on the State of South Carolina Base Map. Why is this area call Santee? Identify this area on the NHAP Transparency. A golf course has a characteristic pattern on aerial photographs. Find a golf course, several lakes, rivers, highways, and bridges.

2. Examine the upper left hand corner of the Vance Topographic Map. Locate as many sinkholes as possible by looking for depression contour markings. Ignore all depressions outlined by blue dashed lines. These are Carolina Bays and are formed by a different process. Using a sheet of tracing paper, mark the location of each sinkhole by tracing the outline of the depression contour lines. Determine and write down the elevation of the center of each depression. Is there any pattern to the distribution of sinkholes? Explain. Is there a pattern to the elevation differences among sinkholes? Explain.

3. Examine the infrared photograph. Look specifically at the region west of Lake Marion on either side of Interstate Highway 95. Can you find the sinkholes you located on the topographic map? Why or why not? Explain. What color of blue on the infrared map do you expect a sinkhole to have? Do you think the sinkholes should have a lot of sediment? Bodies of water carrying a lot of sediment should be lighter blue than clear water which appears black on the infrared photographs.

4. Assume that the water level in the ponds and swamps is the same elevation as the ground water table. Locate the following features in the upper left hand corner of the Vance Topographic Map and calculate the elevation of the ground water table for each location.

Features

Small pond near Mt. Pisgah Church, extreme upper left corner
Small pond, Santee State Park, along upper border of map
Lake in sinkhole in golf course along Lake Marion West bank
Pond in town of Santee, north of highways 15 and 301
Pond South of Bell Cemetery, West side of route 6

5. Groundwater flows "downhill" just like surface water does. The groundwater table in fact slopes "downhill" and groundwater will flow in the direction of that slope towards lower groundwater table elevations. Using your data, predict in which direction a contaminant would flow if it escaped from the sewage disposal pond by the landing strip west of the junction of Interstate Highway 95 and Route 6. Assume the contaminant enters the groundwater system.

ENRICHMENT ACTIVITIES

1. Research the problems caused by sinkholes in Florida. Compare the size of the Florida sinkholes to the South Carolina sinkholes.

2. Write to a limestone quarry such as Martin Marietta Aggregates, Eutawville or Georgetown; Giant Cement Company, Harleyville; Santee Cement Company, Holly Hill; Gifford-Hill Cement Company, Harleyville. Ask for information about limestone deposits. Also, ask for a sample of limestone rock, preferably with fossils. Soak the sample in water and measure how much water is absorbed into the pore spaces of the rock. Break off a very small piece of the rock and soak it in a container of vinegar or other weak acid. Do you observe any reaction? How long does it take for the sample to totally dissolve?

3. Using **South Carolina's Land Resources: A Regional Overview**, page 15, determine the counties that mine limestone.

ACTIVITY B **LAKE MARION**

Materials

1	NHAP Transparency Lake Marion	
1	State of South Carolina Base Map	1:500,000
6	St. Paul, SC USGS Topographic Maps	1: 24,000
6	Vance, SC USGS Topographic Maps	1: 24,000

Activities

1. Notice on both the St. Paul and Vance Topographic Maps that the former Santee River channel is marked with blue dashed lines. Also notice that on the St. Paul Topographic Map, the river channel meanders extensively, while on the Vance Topographic Map the channel is much straighter. What does this fact tell you about the flow pattern and characteristics of the original river? The elevation of the two areas?

2. Compare the east and west banks of Lake Marion as seen on the Vance and St. Paul Topographic Maps. What are the major differences between these two shorelines? How is the major land use different on each side of the lake? Estimate the original flood plain boundaries.

3. Compare the NHAP Transparency of Santee with the Vance and the St. Paul Topographic Maps. If the dam had been built higher and the water level had been 100 feet in elevation instead of 77 feet as it is now, which shoreline would change the most? Why? How would the Santee National Wildlife Refuge be affected?

4. Note the different water colors in Lake Marion as shown on the infrared transparency. What are some possible ways of explaining the difference? Where did this difference originate?

5. Locate the Santee Indian Mound, Fort Watson, the historic site just north of Interchange 102 of Interstate Highway 95 on the St. Paul Topographic Map. How can you recognize this feature on the map? How high is the Indian Mound above the surrounding land? Now look at that same site on the infrared transparency. Can you recognize the Indian Mound? How might you locate this feature on the transparency?

6. Locate the golf course on both the Vance Topographic Map and the NHAP Transparency of Lake Marion. What specific landform features make this a desirable location for a golf course? Explain.

7. Locate Rimini on the State of South Carolina Base Map with Highways. The hazardous waste disposal site is located 200 feet from the headwaters of Lake Marion. Trace the possible route of hazardous waste if it were to enter Lake Marion in that general area and flow to the ocean. Another possible contamination is that of the aquifer.

ENRICHMENT ACTIVITIES

1. Research newspaper and magazine articles on the GSX hazardous waste landfill controversy in the Rimini area. The Item, Sumter's newspaper, is an excellent source to research. What are the greatest potential hazards? What solutions have been recommended? What type of legislation would you recommend to prevent the area from pollution by hazardous waste? Formulate a set of site suitability standards. Write these in a formal request to your legislator.

2. Discuss the pros and cons of selecting a hazardous waste disposal site near Rimini 200 feet from the headwaters of Lake Marion. What type of material is classified as hazardous waste? How is it stored? How long will the lining last that is between the hazardous waste and the underground aquifer? What part does the Santee limestone formation play in the aquifer? Remember an aquifer is the underground "river system" which supplies water to the Coastal Plain Region of South Carolina. Check out how many feet the hazardous waste is stored above the aquifer.

3. Research Francis Marion's escapades. Using the State of South Carolina Base Map trace his campaigns across South Carolina. How did he fit into the defeat of the British?

4. Make a list of all the places, cities, streets, and companies that use Francis Marion's name or the Swamp Fox as their mascot.

5. Research the migratory routes of waterfowl which winter over in South Carolina, and more specifically, those that winter over at Santee National Wildlife Refuge. Where do these birds raise their young? How many? What kind of food attracts them? What are their flyway routes? How are these birds protected?

6. Construct a food chain diagram of a fresh water lake such as Lake Marion.

7. How did the striped bass which is a salt water fish come to reside in Lake Marion? Find out what conditions made this lake a natural habitat for the striped bass.

PLACES TO VISIT

- Santee State Park, located on the west side of Lake Marion just north of Interstate 95, can be reached by taking SC Hwy. 6. Its main attraction is fishing. It also features nature hikes that include Karst topography features such as sinkholes. For information call (803)854-2408.

- Fort Watson, the Santee Indian Mound, was once the site of a small British post captured by Francis Marion. It is located about 1.5 miles north of Santee on US 301 and Hwy. 15. It is located on the Santee National Wildlife Refuge and is available for visits.

- Santee National Wildlife Refuge is located two miles north of Santee on US 301 and Hwy. 15. This refuge provides a haven for thousands of geese and ducks in the fall and winter months. These can be seen from an observation tower on the nature trail between October and March. Make arrangements for a tour by calling (803)478-2217.

- Several cement companies operate limestone quarries in the Coastal Plain region of South Carolina. For special occasions they open specific areas to groups for digging fossils. Prior arrangements must be made.

  Martin Marietta Aggregates has two limestone quarry sites, one in Georgetown and one in Berkeley County.

Georgetown Quarry,	(803)-469-5027
Berkeley Quarry,	(803)-753-2132
Santee Cement Company, near Holly Hill	(803)-496-5027
Gifford-Hill Cement Company of SC, near Harleyville,	(803)462-7651
Giant Cement Company, near Harleyville	(803)496-5033

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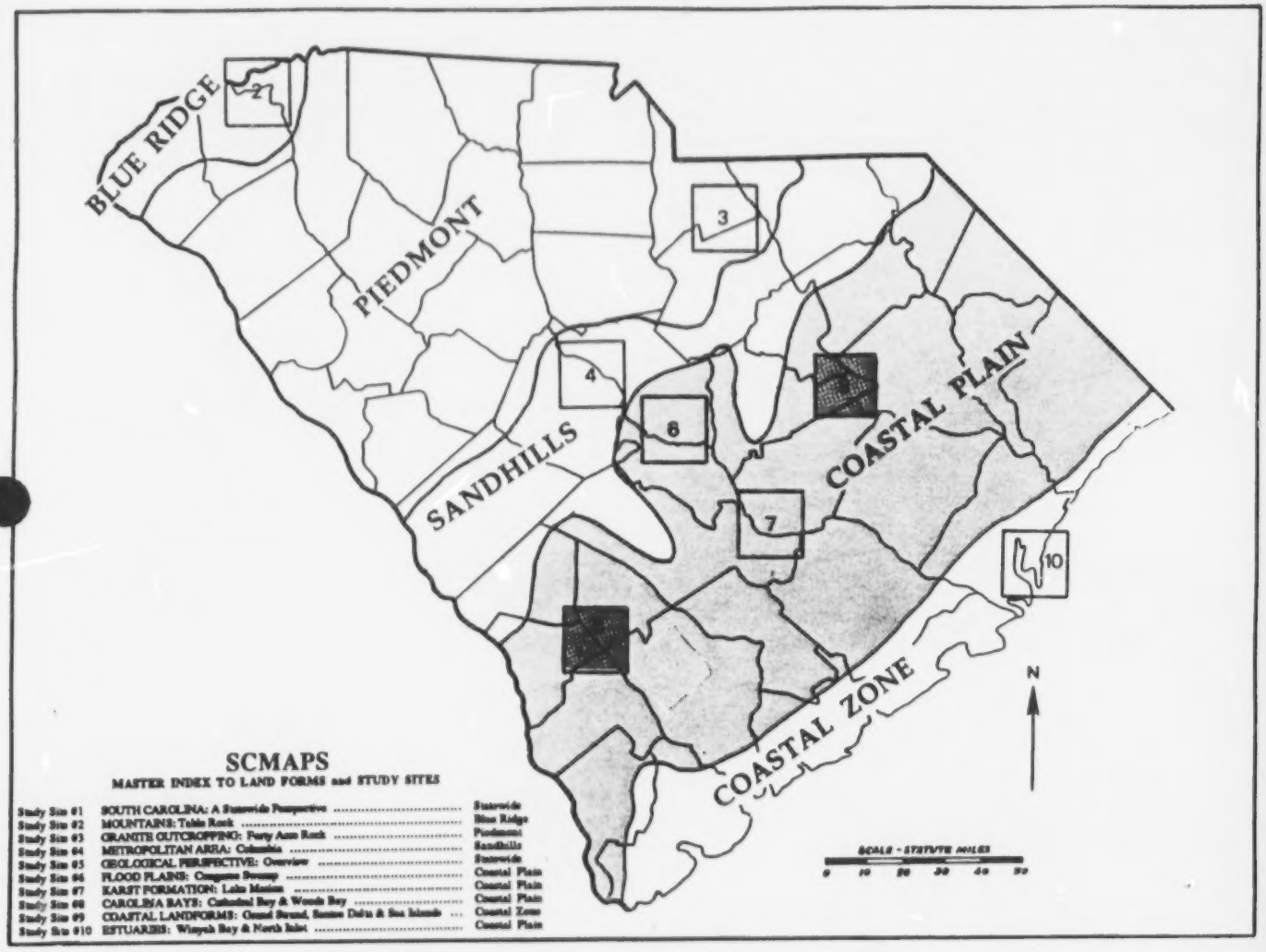
BLUE RIDGE
PIEDMONT
SANDHILLS
COASTAL PLAIN
COASTAL ZONE
2
3
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SCMAPS
MASTER INDEX TO LAND FORMS and STUDY SITES
Study Site #1 SOUTH CAROLINA: A Statewide Perspective ..... Statewide
Study Site #2 MOUNTAINS: Table Rock ..... Blue Ridge
Study Site #3 GRANITE OUTCROPPING: Forty Acre Rock ..... Piedmont
Study Site #4 METROPOLITAN AREA: Columbia ..... Sandhills
Study Site #5 GEOLOGICAL PERSPECTIVE: Overview ..... Statewide
Study Site #6 FLOOD PLAINS: Congaree Swamp ..... Coastal Plain
Study Site #7 KARST FORMATION: Lake Marion ..... Coastal Plain
Study Site #8 CAROLINA BAYS: Cathedral Bay & Woods Bay ..... Coastal Plain
Study Site #9 COASTAL LANDFORMS: Grand Strand, Santee Delta & Sea Islands ... Coastal Zone
Study Site #10 ESTUARIES: Winyah Bay & North Inlet ..... Coastal Plain
SCALE - STATUTE MILES
0 10 20 30 40 50

Study Site #8 CAROLINA BAYS: Cathedral Bay & Woods Bay

COASTAL PLAIN

STUDY SITE 8

CAROLINA BAYS: CATHEDRAL BAY AND WOODS BAY

POWER THINKING

Imagine you are the first pioneer in the area shown on the Olar, SC, Topographic Map. You have explored the entire area and discovered the great variety of plants and animals that will be available to you. Decide where you will build your cabin after considering the following: a) Where you will find the greatest variety of resources? b) Where is your fastest escape route, in case of Indian hostilities or forest fire?

RATIONALE

Of all of the landforms in South Carolina that have intrigued the curiosity of residents and geologists for a solution to their origin, Carolina bays top the list. Since the 18th Century, the Carolina bays have confounded observers. Thousands of these elliptical shaped depressions are located in the Coastal Plain of South Carolina. Probably named for the bay tree, these living zoos and botanical museums are called "a botanical treasure house" (Jones, 1985). With the onslaught of farming and land development, the need to preserve the Carolina bays in their natural state has been recognized. Two have been selected to represent the many bays found in the Coastal Plains of South Carolina. Both are established nature centers.

INSTRUCTIONAL OBJECTIVES

1. Identify the unique Carolina bay formations from aerial photographs and relate the location of these bays to the Coastal Plain area of South Carolina.
2. Compare the Carolina bays, especially the distinct sand ridge on the rim, to the surrounding landscape.
3. Identify the vegetative growth of Carolina bays found in their natural state.
4. Compare current and past theories of the origin of the Carolina bays.
5. Become familiar with the recent efforts taken to preserve the Carolina bays in their natural state.
6. Compare present day land uses of the Carolina bays with those of surrounding areas.

MATERIALS

1	NHAP Transparency Cathedral Bay	1: 58,000
6	Olar, S.C. USGS Topographic Maps	1: 24,000
1	"Marching Bays" - Lewis Bay Complex, Horry County (insert)	Study Site 8-6
1	Big Sister and Little Sister Bays, Marion County (insert)	Study Site 8-7
1	Woods Bay and Dial's Bay, Sumter & Clarendon Counties (insert)	Study Site 8-8

BACKGROUND INFORMATION

Carolina Bays First Identified

Carolina Bays are elliptical shaped geological formations, found in the Coastal Plain of South Carolina, that have intrigued residents beginning with the early settlers. These oval-shaped depressions were generally unnoticed by geologists until aerial photographs made by the United States Geological Survey in the 1930s identified hundreds of these unique bays. Almost one hundred years earlier, **Michael Tourney**, the South Carolina State Geologist in the 1840s, **first described these unique geological formations** (Kaczorowski, 1977). His initial account of the Carolina Bays published in 1848 is as follows:

> *A peculiar feature in the topography of this sand-hill region is the number of circular depressions that are scattered over the surface. They are not deep and conical, like "lime sinks," but flat shallow, at first sight reminding one of a circular race-course.*

Fifty years later in 1895, the term *Bay* was first introduced by **L.C. Glenn** who **described this unique geological feature** in an article published in *Science*. Glenn's description was as follows:

> *Having noted on a surveyor's map of my school district of Darlington, SC, several lake-like expanses usually represented as being at the head of some very small stream, I began inquiries concerning them and followed this up by visiting several of the largest.*
>
> *To the lake-like expanses the term bay is usually applied and by it is meant a perfectly flat, clayey area with a surface some two to four feet below the general level of the country and varying from a few acres in size to stretches a mile or two long and a half mile or more in width; the smaller ones being much more numerous and having usually an area of 20 to 30 acres. They are in some cases approximately round in shape, though they are usually ovoid or elliptical, and are covered with vegetation-stained water from a few inches to a foot or two deep according to the season. Growing in this water, where the bay is uncleared, are cypress, juniper or black-gum trees with a moderately thick swamp undergrowth.*

Glenn's account of the Carolina Bays, describing this unique geological feature almost one hundred years ago, remains as a valid sketch today. Additional investigations have shown that **all of the Carolina Bays are smooth elliptical depressions several feet deep, oriented in the same northwest to southeast direction with a surrounding rim of sand that is most obvious along the southeastern edge.**

Theories of Origin

The origin of the Carolina Bays has intrigued the curiosity of residents and geologists for years with many theories having been proposed and investigated. The development of scientific knowledge begins with a systematic investigation of a proposed hypothesis. Next, data is gathered and analyzed to determine if it fits the model of the hypothesis. Repeated investigations must be made to verify the hypothesis. If all the data is conclusive, then the hypothesis becomes scientific knowledge. If there is not enough data to substantiate the hypothesis, then the theory is rejected. This is the nature of science or the way science knowledge is generated. In the case of a solution for the origin of the Carolina Bays, there is no conclusive data that substantiates any of the theories. The origin of the Carolina Bays is still a mystery waiting for a solution.

With the advent of aerial photographs in the 1930s, a number of geologists and local citizens became interested again in these features. Many theories (hypotheses) of their origin **began to emerge**. Some are whimsical and some within the realm of possibility. These theories include:

- A basin for giant turtles,
- Fish nests made by giant schools of fish waving their fins in unison over submarine artesian springs,
- An extraterrestrial origin where meteorite showers struck the earth causing depressions on the land,
- Sinkholes in limestone solution areas,
- Solution basins of artesian springs, and
- Natural circular depressions in the ground coupled with the prevailing winds resulting in elongation of the depressions and deposit of sand on southeast northwest perimeter of the bay.

Of all the theories (hypotheses) that surround the origin of the bays, the one that has captured the most attention and imagination is the suggestion of **extraterrestrial origin**. This theory, proposed by Melton and Schriever in 1933 hypothesized, that the Carolina Bays were caused by the impact of a cluster of meteorites striking the earth. The theory was based on the smooth elliptical shape, the peculiar rim of sand found predominantly on the southeastern edge, and a similar northwest orientation of all the bays.

Many geologists have conducted surveys trying to substantiate these theories. In 1952, Prouty carried out magnetometer surveys in an attempt to locate magnetic properties associated with meteorite material. His data was not conclusive. He also conducted projectile experiments using a .38 caliber bullet to determine if elliptical depressions could be made at a small angle of impact. The conclusion of his data indicated that a meteorite could have produced an elliptical depression but it would have been 2-3 kilometers deep with an uneven bottom. The bays are flat depressed areas a few feet below the surface of the ground. Using a comparison of known craters caused by meteorite showers, most geologists now believe the evidence indicates that the Carolina bays are not caused by extraterrestrial forces.

Many of the early hypotheses have been eliminated because conclusive data did not match the theories. The wave theory that **giant schools of fish waved their fins in unison over submarine artesian springs** has been eliminated because the depressions are flat and shallow. Waves would have left an uneven bottom profile. The artesian springs were never found, eliminating that theory. Likewise, the limestone sinkholes theory was never substantiated because of the lack of calcium carbonate deposits.

Origin Remains a Theory

The **current theory** that prevails is based on a **terrestrial origin** of these bays. Natural depressions in the Coastal Plains caused circular lakes to form. The prevailing winds over a long period of time resulted in these circular lakes elongating into elliptical shaped basins. The winds also caused sand to be deposited on the perimeter of the bays with the greatest amount deposited on the southeastern rim where the wind velocity decreased. This occurred before heavy vegetation covered the bays. One piece of evidence to substantiate this theory is that radioactive Carbon-14 dating indicates the bays are not all the same age. The ages vary from 6,000 to 50,000 years. Using the terrestrial origin of circular depressions coupled with prevailing winds, the bays could very well have been formed over a long period of time.

The very nature of science indicates that any theory must undergo constant scrutiny; therefore, the origin of the Carolina bays remains a continuing and intriguing mystery perhaps awaiting another solution. As more evidence is recorded perhaps still other theories will be proposed that could explain the data.

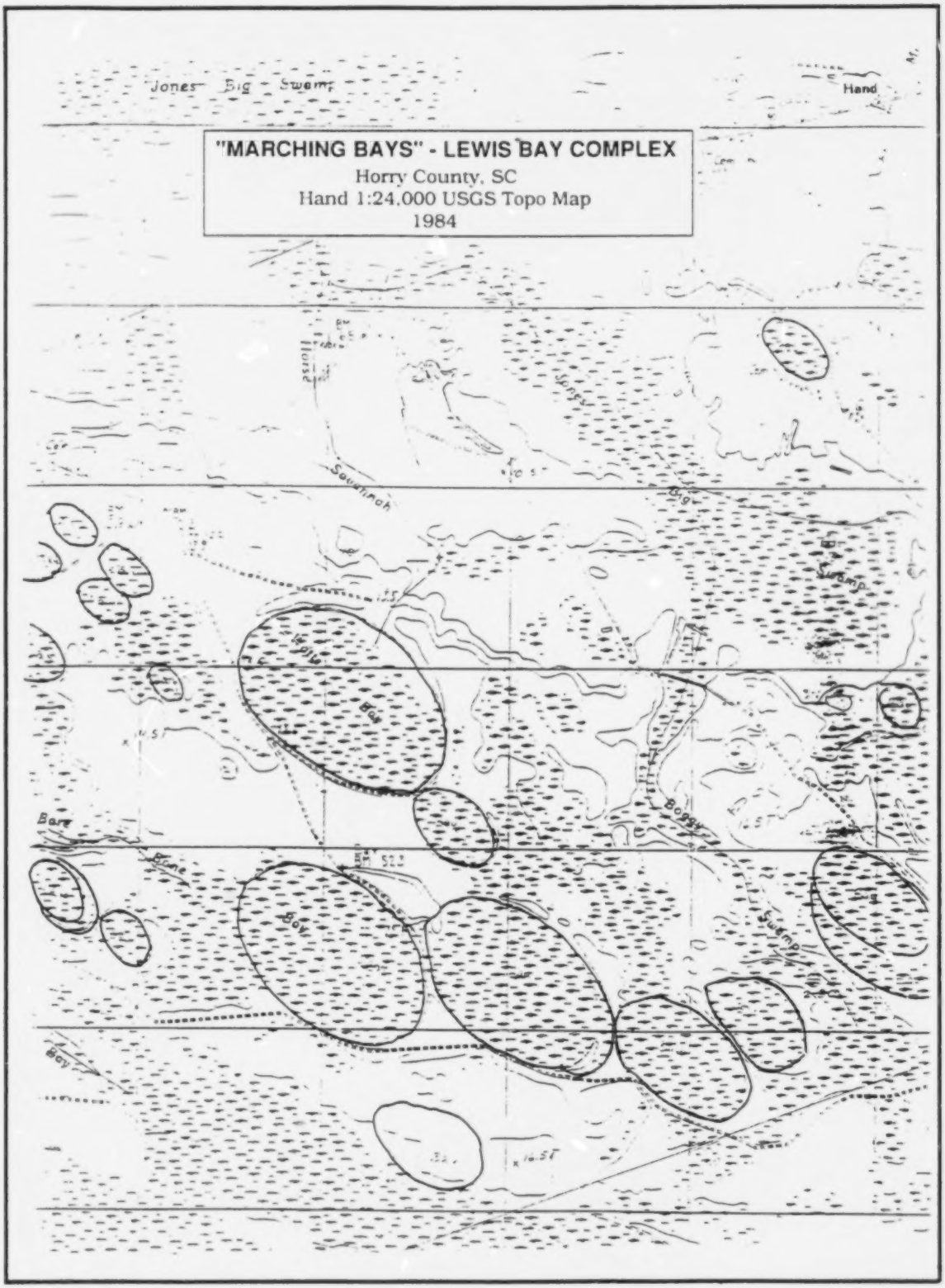
Recent Efforts to Preserve the Carolina Bays

Many of the Carolina Bays have succumbed to a need for farmland. They are being logged, cleared, plowed, sliced up by roads, and developed at an alarming rate. In a survey made by the South Carolina Wildlife and Marine Resources Department, 2651 bays over two acres or more in size were identified. It has been estimated that only 400 to 500 bays are still relatively untouched. **Woods Bay in Sumter County**, preserved in its natural state and once the site of a water powered grist mill, is part of the South Carolina State Park system. Several other bays have been protected as nature preserves through the Heritage Trust Program. **Cathedral Bay in Bamberg County** was purchased and is now under the care of this public foundation. Several other bays purchased by the Heritage Trust Program include **Junkyard Bay in Clarendon County, Cartwheel Bay in Horry County, and Savage Bay in Kershaw County**. Bays are being preserved so that future generations will be able to continue to enjoy these unique elliptical shaped "botanical treasure houses" the search for their origin.

Several topographic map inserts of bays have been included because of interesting groupings. **"Marching Bays" called the Lewis Bay Complex**, Study Site 8-6, located in Horry County show a group of bays in stair step sizes. **Big Sister and Little Sister Bays** in Marion County, Study Site 8-7, are a pair of bays sitting side by side; one has been drained for agricultural purposes the other one is still in its natural state. The topographic map insert of **Woods Millpond and Dial's Bay**, Study Site 8-8, located in Sumter and Clarendon Counties was made in 1946 while Woods Bay was being logged and before it became a state park. On site educational programs are available at both Woods Bay State Park and Cathedral Bay Heritage Preserve.

Summary

The Carolina Bays are interesting geological formations that have intrigued South Carolinians. Even though the origin of the bays has never been clearly defined, the need to preserve these unusual formations has become an important issue. The public needs to become better acquainted with Carolina Bays and their characteristic environment that provides a living zoo and botanical museum for all to appreciate.



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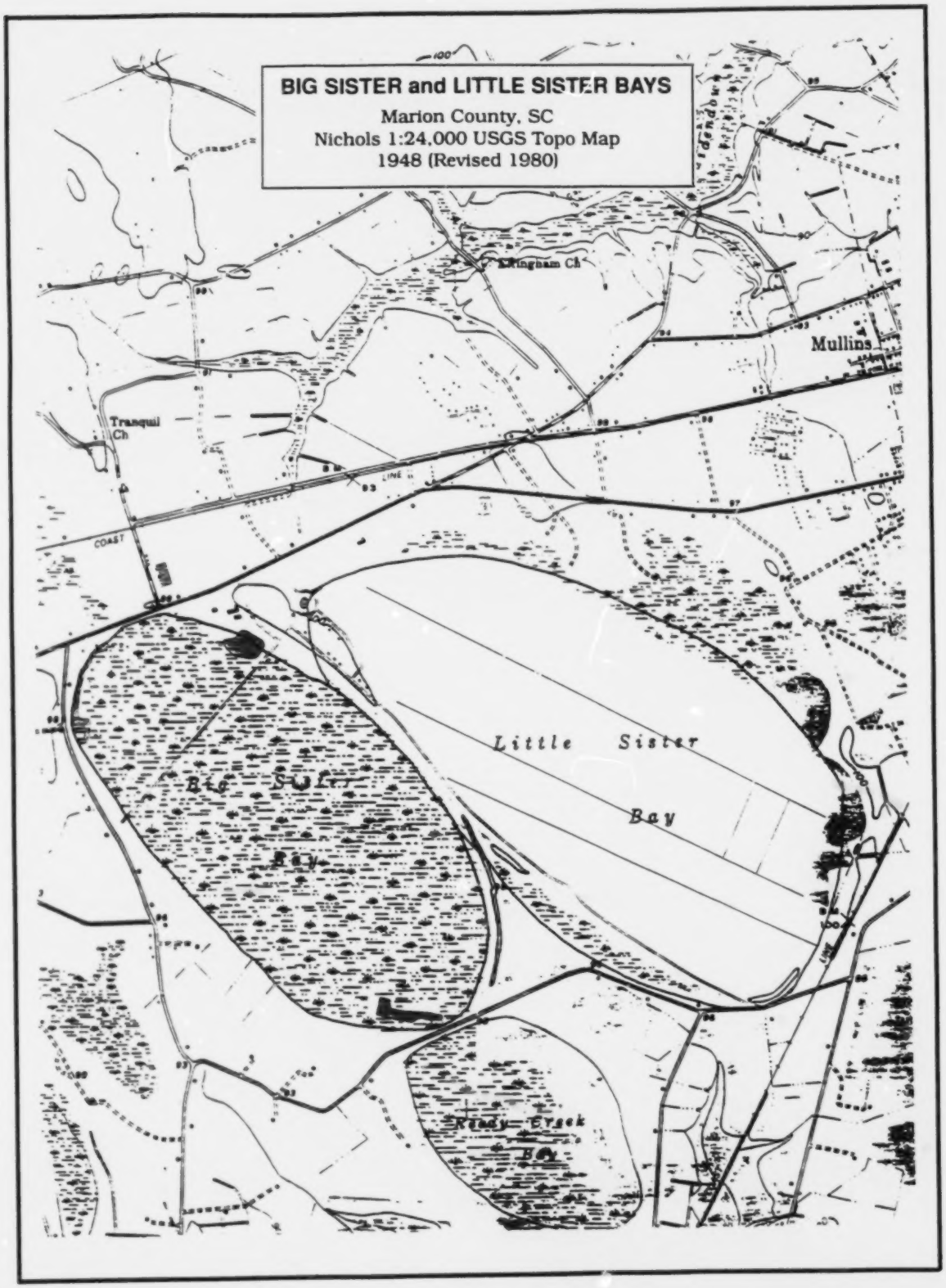
COASTAL PLAIN - Carolina Bays Study Site 8-6


BIG SISTER and LITTLE SISTER BAYS
Marion County, SC
Nichols 1:24,000 USGS Topo Map
1948 (Revised 1980)
Mullins
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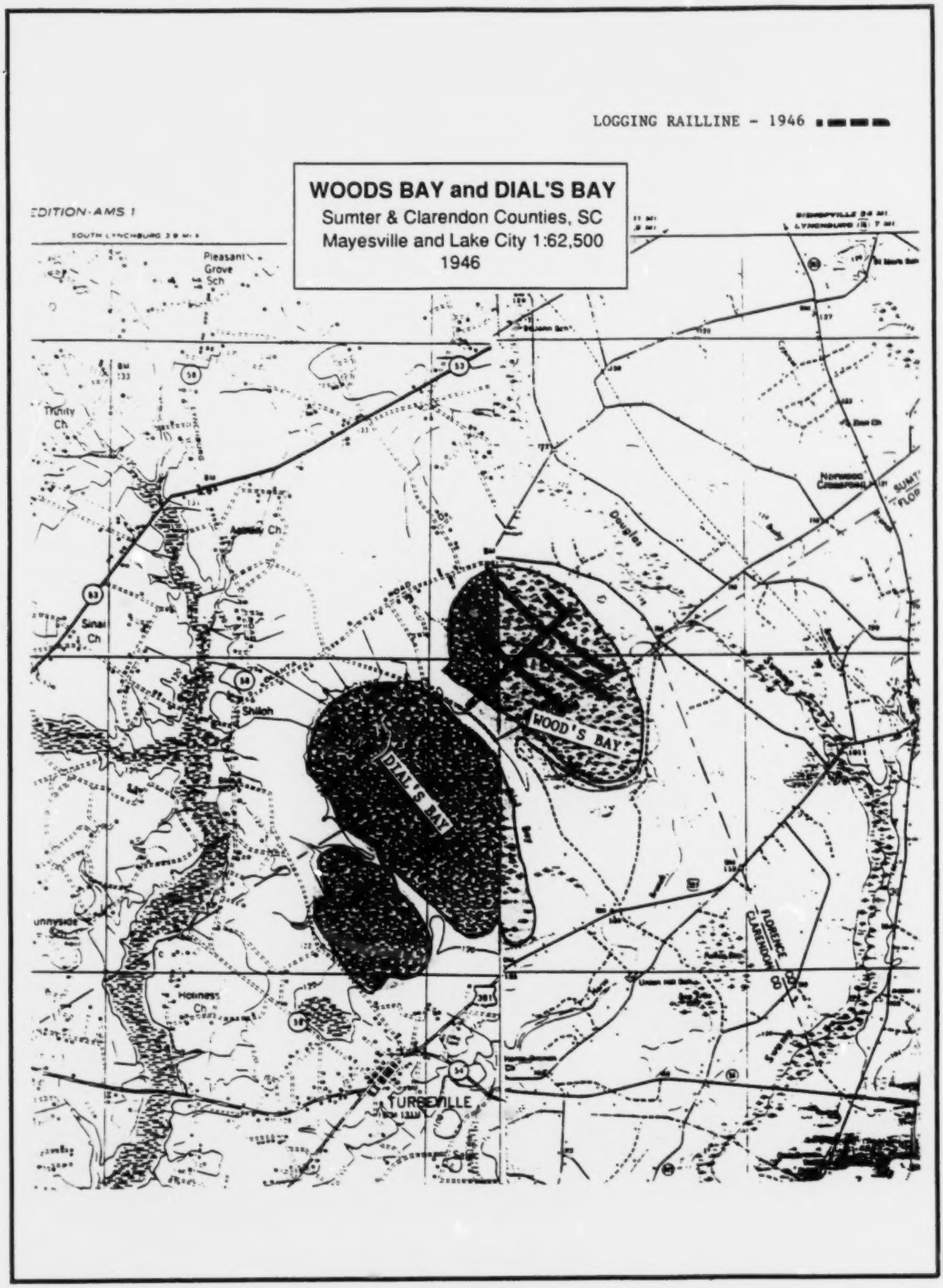
LOGGING RAILLINE - 1946



INSTRUCTIONAL STRATEGIES

ACTIVITY A CATHEDRAL BAY

Materials

1	NHAP Transparency Cathedral Bay	1: 58,000
6	Olar, SC USGS Topographic Maps	1: 24,000

Activities

1. Which town is located in the center of the Olar Topographic Map? Name the main river and its tributaries flowing through this area. Suppose you were riding down the Salkehatchie River in a boat, describe the banks. How far above sea level would you be if you climbed to the highest point on this map? How far would you be above the river? Where is the steepest slope on this map?

2. Locate the Seaboard Coast Line railroad tracks now called CSX. What would be the probable destination of a North bound train? Southbound train? What types of products would the town of Olar be exporting? Importing?

3. Find areas on this map that would be good for fishing, farming, building an air field, and hiking. Give reasons for your choices.

4. Count the number of Carolina Bays on this topographic map. What is the height above sea level for most of the bays? Are all of the bays oriented in the same direction? What direction is this? Identify the largest bay on this map? What is the length and width of this bay? Identify the sand ridge on the rim of the bays. Do many of the bays have an obvious sand rim on the southeastern edge?

5. Identify Cypress Bay. Recently the name of this bay was changed to Cathedral Bay Heritage Preserve. It was renamed when the Nature Conservancy purchased the land for a wildlife preserve. Using the scale bar, determine the length and width in miles of this bay. Convert this figure to acres? What is the elevation of this bay?

6. Compare the Olar Topographic map to the NHAP photograph of the same area. What are the land uses of the bays located on this map? How is most of the land used? How many of the bays have been drained and are now considered farm land?. Which animals would you expect to be found in Carolina bays? Which trees would thrive in these bays? Does the sand ridge look different?

7. Make a profile sketch of a typical bay including the sand ridge. Use symbols to indicate the type of plants that dominate your bay. Be sure to identify the sand ridge and the type of plants most often found in this type of soil.

ENRICHMENT ACTIVITIES

1. List the pros and cons of the proposed theories for the origin of the Carolina bays. Discuss the possibility of proving each theory. Make up your own theory of the origin. What steps must you take to prove your theory.

2. Describe the ecosystem of a bay. Make a list of their important features.

ACTIVITY B **MARCHING BAYS, WOODS BAY & SISTER BAYS**

Materials

1	"Marching Bays" - Lewis Bay Complex (insert)	Study Site 8-6
1	Big Sister and Little Sister Bays (insert)	Study Site 8-7
1	Woods Bay and Dial's Bay (insert)	Study Site 8-8

Activities

1. Marching bays are named from the pattern formed when several bays are found sitting side by side and appear to be grouped together. The topographic map insert illustrates a group of marching bays found in Horry County Northwest of Myrtle Beach near Hand, SC. Determine the magnitude of the largest and smallest bay in this grouping. Use the scale bar to determine the square miles and then convert this to acres.

2. Locate the sand ridge on the perimeter of these "Marching Bays." What direction are these bays oriented? Where are the nearest swamps? Are these bays part of the swamps? What is the highest elevation of this map insert? What does BM stand for?

3.. Big Sister and Little Sister Bays typifies the diverse land use. Located near Mullins, one bay is preserved in it's natural state, while the other one has been drained for agriculture. What is the elevation of these bays? Identify the sand ridges on the rim of Big Sister Bay. What direction are these bays oriented? What is the highest elevation point on this map insert? Contrast the pros and cons of preserving a bay versus draining it for agriculture.

4. Woods Bay (Woods Millpond) and Dial Bay sitting on the Sumter-Clarendon County line near Turbeville are another pair of bays. Woods Bay State Park is an excellent example of a bay that has been preserved in its natural state. Note the tram roads running through Woods Bay on this map. The original USGS topographic map was made in the mid 1930s when tram roads had been built for logging. Since this map was made, Woods Bay has been preserved in its natural habitat and Dial Bay has been cleared for agriculture purposes. Another important change has been the addition of Interstate 95 running very close to these two bays. What is the elevation of Woods Bay? Dial Bay? Which direction is the water flowing in Douglas Swamp? Pudding Swamp? How large are these bays in square miles? In acres?

ENRICHMENT ACTIVITIES

1. Request a copy of the Carolina Bay Project survey results made by the South Carolina Wildlife and Marine Resources, Heritage Trust Division. What has been done to preserve the bays? What is the value of these unique wetlands? What are some of the rare plants found on the federal endangered species list? As a citizen, what can you do to save these bays?

2. Investigate the problems associated with converting the Carolina bays to agriculture and commercial developments.

3. Identify the sand ridge on the southeastern rim of the bays. Describe the plants that are found growing on this sand ridge. Why is this a different ecosystem?

PLACES TO VISIT

- Plan to visit a Carolina bay. There are two excellent examples of typical Carolina bays in their natural habitat designed for field trips. Each site has developed an educational program especially for students. These programs can be scheduled upon request.

  Cathedral Bay Heritage Preserve, Olar, Bamberg County (803)734-3893

  Woods Bay State Park, near Turbeville, Sumter-Clarendon Counties (803)659-4445
  A 700 foot boardwalk allows visitors to walk into the bay and observe plant and animal communities in their natural habitat.

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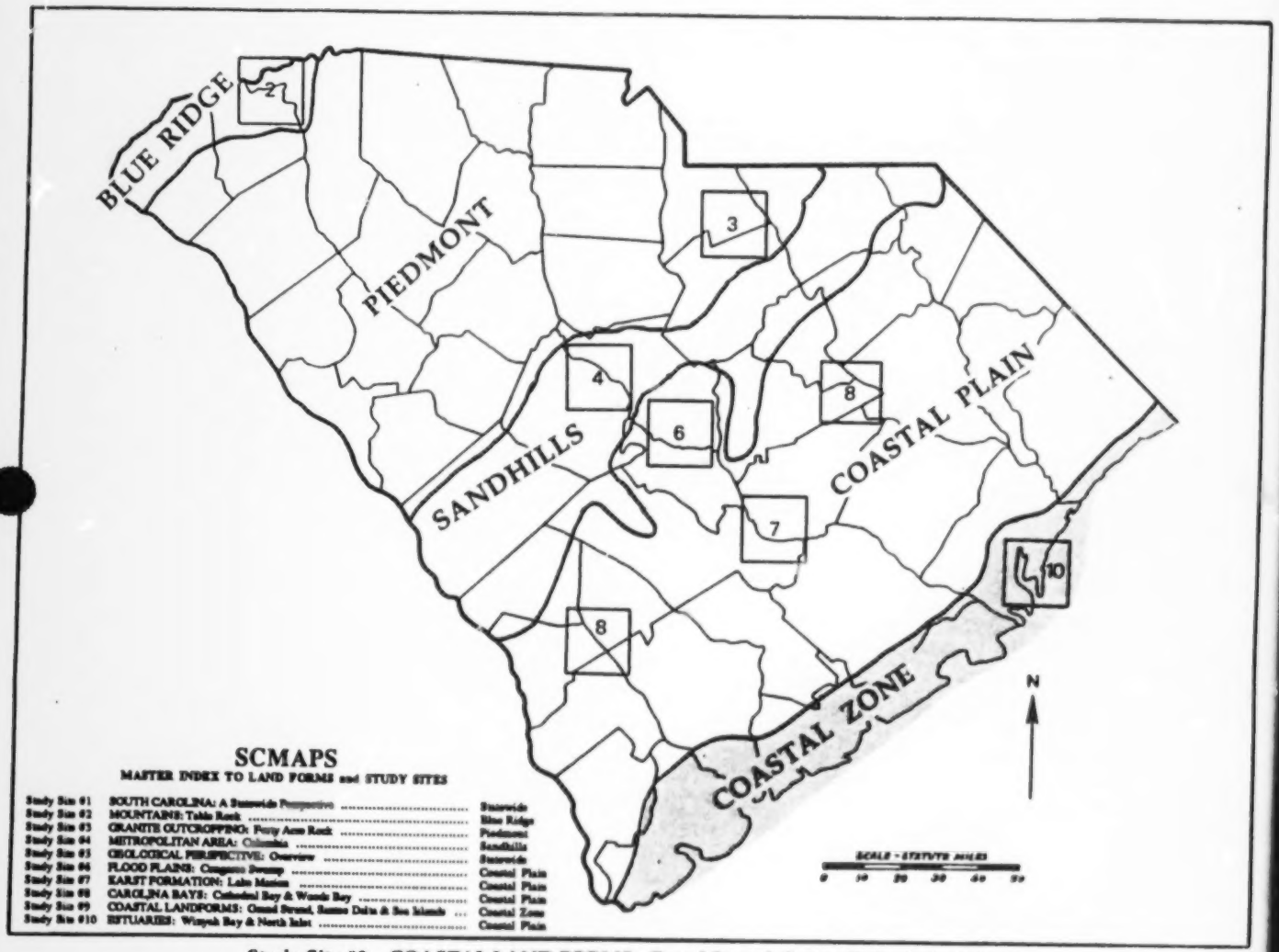
BLUE RIDGE
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MASTER INDEX TO LAND FORMS and STUDY SITES
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Study Site #2 MOUNTAINS: Table Rock ..... Blue Ridge
Study Site #3 GRANITE OUTCROPPING: Ferry Acre Rock ..... Piedmont
Study Site #4 METROPOLITAN AREA: Columbia ..... Sandhills
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Study Site #9 COASTAL LAND FORMS: Grand Strand, Santee Delta & Sea Islands

COASTAL ZONE

STUDY SITE 9

LANDFORMS: GRAND STRAND, SANTEE DELTA, AND SEA ISLANDS

POWER THINKING

You are part of a National Geographic team making a television special about the South Carolina coast. You have in front of you one of the State of South Carolina Base Maps. Where will you film the longest stretch of beach? Where will you film the largest estuary? Where will you film the largest concentration of inlets?

RATIONALE

The coastal zone of South Carolina has a unique, intriguing, and diversified landscape, steeped in history and rich in natural resources. Three diverse landforms make up South Carolina's coastline and specific activities have been chosen to represent each of these distinct areas: the Carolina Grand Strand with its broad sandy beaches; the Santee Delta, second only to the Mississippi Delta in size in the United States; and the Barrier Islands with migrating patterns of erosion and deposition. The maps selected for this study site will permit a closer look at several interesting features that reveal evidence of past and present geological processes. All have influenced historical development and current land use. Recent economic trends and ecological threats will be explored to develop an understanding of the necessity to conserve precious coastal resources.

INSTRUCTIONAL OBJECTIVES

1. Identify the characteristics of the three distinct South Carolina coastal landforms.
2. Compare coastal processes of erosion and deposition in the shaping and migration of barrier islands.
3. Understand the process and the importance of tides in shaping the coastal zone landscape.
4. Recognize evidence for historical sea-level changes and patterns of deposition on the continental shelf.
5. Describe the impact on the Santee Delta as a result of man-made reservoirs in the Santee drainage basin.

MATERIALS

1	NHAP Infrared Transparency Winyah Bay	1: 58,000
1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Shaded Relief Map	1:500,000
6	North Island, SC USGS Topographic Map	1: 24,000
6	Waverly Mills, SC USGS Topographic Map	1: 24,000
1	Santee Delta Map	Study Site 9-5
6	North Island 7.5 USGS Map, NOS Shoreline Movement	Study Site 9-6

BACKGROUND INFORMATION

Processes Shaping South Carolina's Coast

South Carolina is fortunate to have an extensive **200 mile coastal area** as one of its boundaries. If you included all of the bays, sounds, inlets, and marshes, it is 3000 miles long. Furthermore, the coast is within a pleasant drive from all parts of the state. Comparing South Carolina with other states, only a few have the advantages of a coastal area, and none have one that is as diverse, intriguing, and delightful to explore as our Carolina coast. All of South Carolina's Coastal Zone is influenced by the rise and fall of tides. This tidal effect extends approximately ten miles inland and includes all of the major bays, sounds, and inlets. The industrial port cities of Georgetown, Charleston, and Beaufort are located in this landform region, as well as many coastal tourist resort areas. Viewed in geologic time, South Carolina's coastal region developed through the deposition of sediment eroded from the Appalachian Mountains. These sediments built out into the ocean and have been rewired and sculptured into the landform structures of today's coast and beach areas. **The coastal landforms of barrier islands and beaches are geologically younger than other South Carolina landforms**, forming within the last **4,000 years**.

During the quaternary period ice ages, sea level rose and fell several times causing shoreline features to recede and advance. Sand dune remnants in the Coastal Plain Region and a series of escarpments and terraces are evidence of the receding shoreline. Still present on the Continental Shelf off our coast are other remnants of escarpment and terraces. From 20,000 years until about 4000 years ago, the **glaciers of North America were melting rapidly**, causing the sea level to rise several feet per century, a total of over 350 feet. As sea level rose during this period, flooding out-paced deposition of sediments carried by rivers. **Beaches existed but shifted their position inland to keep pace with the rising sea.**

South Carolina's present day barrier islands and beaches began to grow, and the wetlands and estuaries behind the outer beaches began to evolve around 4000 years ago when sea level finally stabilized allowing sediments to filter out of the rivers as they met the ocean. The river sediments, a mixture of sand, silt, and clay accumulated, according to the intensity of wave and current energies, causing sand to be deposited near beaches and finer silt and clays to settle in marshes and as offshore mud deposits.

Although **wave and tidal actions** are most responsible for short-term beach erosion and accretion development, these processes over long periods of time have also **created parallel rows of dune ridges behind the active shoreline**. Such activity has helped build the present day **barrier islands** typical of the South Carolina coast and the tidal coastal zone in general. These dune ridges over time have become vegetated by what is typically called a **maritime forest**. Younger sand ridges closer to the beach front are dominated by sea oats and other salt-tolerant shrubs and grasses.

In recent times, **the most dramatic Coastal Zone changes have occurred as the result of major storm or hurricane events**, however, in the long run, subtle changes are important in shaping overall coastal zone landscapes. Natural factors such as tidal cycles, currents, waves, storms and winds, and man-made factors like dams on rivers, shore front development and the construction of jetties, groins, and sea walls, all have an impact on the configuration of the shoreline.

The South Carolina Coastal Zone is divided into three distinct geographic areas based on different landforms produced by geological processes. Each distinct area can be easily identified. The first area is the crescent shaped beaches referred to as the **Carolina Grand Strand or Myrtle Beach Grand Strand**. The next area is a typical delta known as the **Santee Delta**. The third geological area comprises the **Sea Islands** and includes a the marsh complex extending from the Santee Delta to the Georgia border. Often, these features are referred to as **Barrier Islands** as they serve to protect the mainland from waves, tides, and hurricanes coming from the Atlantic Ocean.

Carolina Grand Strand

The crescent-shaped beach (the arcuate strand) stretching from the North Carolina border to Winyah Bay at Georgetown is often called the *Myrtle Beach Grand Strand* or *South Carolina Grand Strand*. It is characterized by a 100,000 year old sand barrier formation which is paralleled by the Waccamaw River. There are only a few tidal inlets in this landform region namely Murrell's Inlet, Pawleys Island Inlet, and North Inlet. The stable grand strand landform has greatly influenced the location and direction of the Waccamaw River, thus creating the historic *Waccamaw Neck* easily identified on the study site maps.

Santee Delta

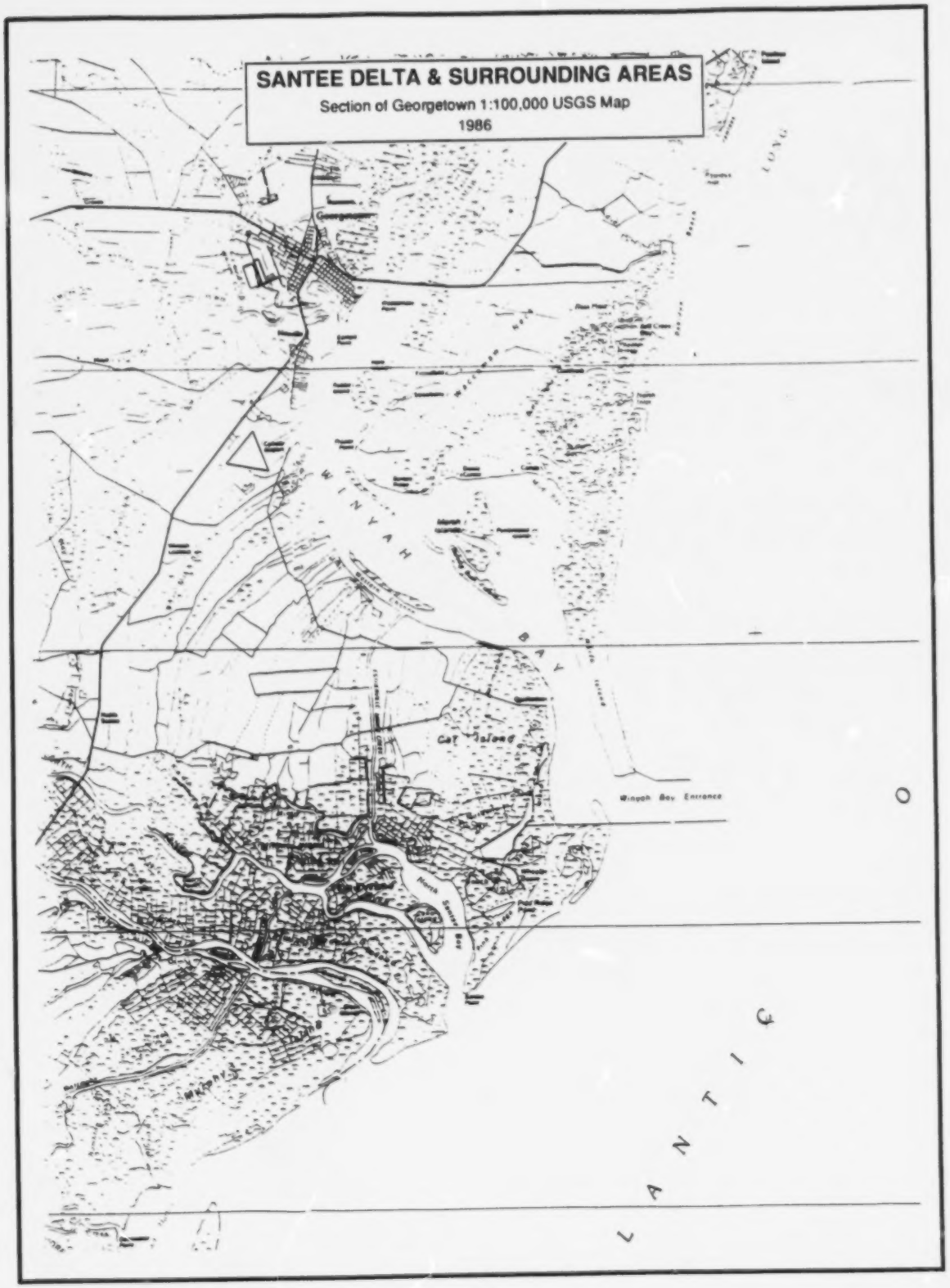
The *Santee Delta*, located south of Winyah Bay at the mouth of the Santee River, forms another distinct area. It is **the largest pointed delta on the east coast** and is similar in formation to the Mississippi Delta. The Santee River basin is significant because over 40% of South Carolina's land area is drained by this system, a fact which has greatly influenced the delta's formation. In 1942, a project under the direction of the United States Corp of Engineers diverted the water in the Santee River to the Cooper River by developing a series of reservoirs connected with a canal. This is known as the *Santee Cooper complex*, consisting of Lake Marion, Lake Moultrie, and the Tailrace Canal. **The purpose of this project was to create hydroelectricity and provide a water transportation route to the port city of Charleston.**

As a result of the Santee Diversion Project, most of the water from Lake Moultrie flows into the Cooper River and on down to Charleston. The increase in sediment load in the Cooper River has resulted in the need for continuous dredging, while the decreased sediment load in the Santee River has resulted in the erosion of the Santee Delta. Recently, through the Re-diversion Project on Lake Moultrie, a large channel has changed the direction of the water. Now, a significant part of the water flows back into the original Santee River basin.

The *Santee Delta* (insert Study Site 9-5) is a triangular or fan shaped deposit at the mouth of Santee River. Most of the sediment load carried by a river is deposited when it reaches the relatively quiet waters of the Atlantic Ocean. The Mississippi Delta is steadily growing into the sea, while the Santee Delta due to the diversion project has undergone erosion. Deltas are characterized by capes which jut out into the ocean and elongated spits (narrow peninsulas of sand) off the headlands. Behind the elongated sand spits of the Santee Deltas is a series of marshes, which are very productive in terms of seafood and provide **one of the most magnificent waterfowl and bird rookeries on the east coast.**

Sea Islands

The third area on the South Carolina coast is characterized by islands and salt marshes and is called the **Sea Island** province or more commonly the barrier island province. This area of the coast is made up of numerous inlets, bays, and islands. **Two distinct island formations are found in this region.** These are the **remnant islands and the barrier islands**, which differ widely in origin, use, and coastal processes. **The remnant islands are thought to be caused by erosion from the mainland.** Very few coastal processes are currently altering these islands. Examples are St. Helena Island, Hilton Head, and Kiawah Island. Often referred to as *beach ridge barrier islands*, these islands contain interior wetlands and waterways, are several miles wide, and have mature maritime forests on the landward side.



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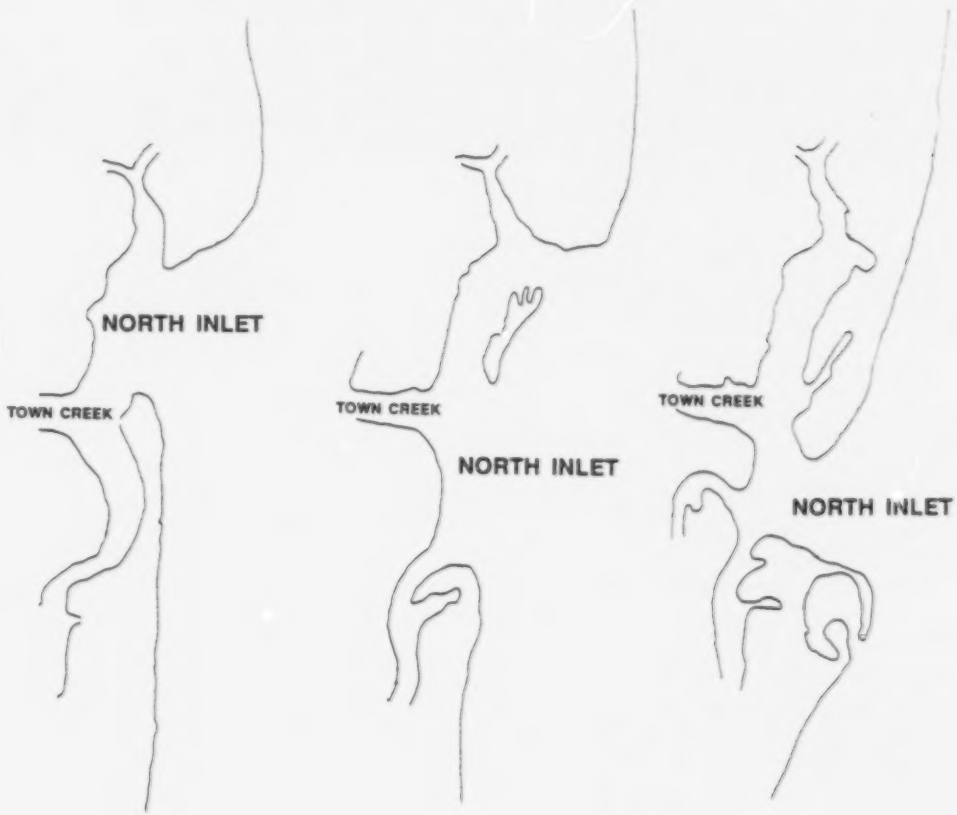
NOS SHORELINE MOVEMENT STUDY
NORTH ISLAND 7.5 USGS MAP



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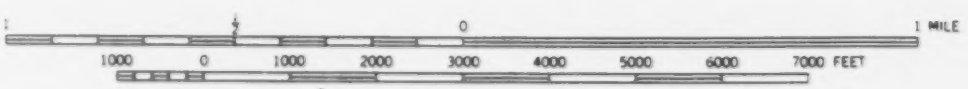

The other group is the **barrier islands.** Often called transgressive barrier islands, this group of sea islands are constantly undergoing changes made by wind, tides, wave action, storms, and currents. All barrier islands are very unstable causing changes in the coastline. In most cases, **the northern end of the island is eroding and the south end is experiencing deposition**. Examples include Folly Beach, Fripp, Bull, and Hunting Islands. Within the detailed study site, the areas around North Island provides an excellent example of the dynamics of these transgressive barrier islands. The NOS Shoreline Movement Study of North Island taken from a 7.5 minute USGS compares the shoreline movement of North Inlet covering a period of over 100 years. During this period of time North Inlet has undergone extensive erosional changes.

Transgressive barrier islands can be identified by lack of vegetation, wash-over deposits from tides and storms, and frequent shifting sand-bar formations. The location and direction of tidal inlets plays a major role in the erosion, deposition, and migration of barrier islands. Man has attempted to influence the erosion/deposition processes by building navigation jetties, sea walls, and groins like the structures found at Winyah Bay and Pawleys Island Inlet.

Beaches and Dunes

Beaches and dunes are formed through time from the transport of sand by water and wind. Currents, winds, and other physical processes are responsible for the constant re-shaping of sand dunes which form the basis for beaches and barrier islands. Beaches protect the highland areas by absorbing wave energy. Dunes serve as reservoirs of sand to replenish beaches during erosive events caused by storms.

Beach sand is transported by *littoral drift* which moves sand from offshore sand bars into the surf zone by wave and tidal action. In accretion areas, where land is built up by deposits of sand from the ocean, wind carries the loose particles up onto the higher beaches. A variety of debris breaks the force of the wind and the sand is deposited forming sand dunes. Sea oats and other beach front grass seeds germinate and grow. The grasses then provide more wind-blocks for further sand accumulation and greater dune stabilization. The slow movement of sands and sandbars through time is easily seen in aerial and satellite photographs. Dune ridges built by this process are also obvious features on both types of photographs.

South Carolina Hurricanes

The most dramatic changes to coastal landscape are hurricanes and tropical storms which enter the state every four to five years and are considered irregular visitors. In the Colonial period, these storms were called *September gales*. Often whole crops were destroyed just before harvest time. Hurricanes are born in the tropical and subtropical North Atlantic Ocean, near the Cape Verde Islands off the coast of Africa, in the Caribbean Sea, or in the Gulf of Mexico. If the eye of the hurricane passes over land during high tide, the damage is increased. Often a storm surge develops, which can submerge an entire island.

The Hurricane of 1893

The following excepts are taken from a personal account told by Dr. J. Ward Flagg about his family's vacation at Magnolia Beach.

> *...It all happened on the 13th – a bad luck day the 13th – a Friday too, the 13th of October 1893, when the great storm came and made the new inlet and filled up the old inlet...*

It was ten o'clock in the morning when the terrible storm blew out of the east...all at once it got blacker and blacker so that it was just like the middle of the night. The big waves began to come way up the beach, rushing toward the house and we stood, my father and my brother and I, to watch the storm. My father said, "I am afraid we may lose the house." I got two axes and began tearing away the floors in the piazza...so that the rooms downstairs could fill with water and keep the house down. But the roof of the porch caved and I said – Run – everybody – run and swim all to the tree....the tree was an old gnarled husky cedar, very strong and spreading. There were fifteen servants...my father was 65 but my mother was 60 and she was in her prime. We got to the tree and we all crowded under the spreading branches and held on tight as we could but the water kept sweeping over us and then we would be beaten under again. My little niece was with me and I took a piece of the flooring I had split off and braced her with the nurse's son in a crotch of the cedar tree. We held on like leeches – lashing (locking our) legs and arms over and around the cedar.

...He (my father) put his arms around her (my mother's) waist and held her up close to him and she put her arms around him right under his arm pits...she would try to push him up when the water came and he would get down on the tree and try to push her up. The last time I saw them come up, they were just like always...my father had her close in his arms. Maybe they could have gotten out of it if it had not been for a wire fence my father had put around the house. The water came just like a wall around us and the fence wrapped around anybody who tried to swim through it.

All at once, just like it had come on us, the wall of water began to go down again in a little while the tree was not under water and my niece, and my man here and five servants were clinging like leeches....The house was gone and they (my father, brother, and mother) were all gone...It all happened on the 13th of October...It was Friday and Friday the thirteenth is a bad luck day."

Many hurricanes are remembered long after they occur because of the destruction to families and property. Hazel in 1954 came in around the North Myrtle Beach area, while Gracie in 1959 hit St. Helena Island outside of Beaufort. Both of these hurricanes caused tremendous damage while changing the coastal beach boundaries. Now, hurricanes are constantly monitored by the National Weather Service and South Carolina State Climatology Office. Warnings are reported on the news in order to keep the public informed. On numerous occasions beaches are evacuated as the hurricane approaches to protect people from harm. Hurricane warnings must be heeded as past experience tells us of the dangers associated with our unwieldy visitors from the sea.

Summary

The South Carolina Coastal Zone is divided into three distinct geographic areas based on different landforms produced by geological processes. Winyah Bay marks the boundary between the Grand Strand and the Santee Delta, while the Sea Islands extend from the Santee Delta to Georgia. The selection of North Island facilitates the study of these three diverse landforms because of the close proximity of these landforms to the area.

Distinction is made between the remnant islands and the barrier islands found along the coast. The remnant islands are thought to be caused by erosion from the mainland undergoing very little change. The barrier islands on the other hand are constantly undergoing changes made by wind, tidal action, storms, and currents. In most cases the northern end of the island is eroding while the south end is experiencing deposition. The most dramatic changes to the coastal landscape are the hurricanes and tropical storms which enter the state periodically from the coast. Throughout the study of this site, the level of concern must be raised so that the economic trends and ecological threats will be explored. It will be imperative to preserve the coastal resources of our Carolina coast for future generations to enjoy.

INSTRUCTIONAL STRATEGIES

ACTIVITY A COASTAL LANDFORMS

Materials

1	NHAP Infrared Transparency Winyah Bay	1: 58,000
1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Shaded Relief Map	1:500,000

Activities

1. Using the State of South Carolina Base Map with Highways or the Relief Map, identify the Carolina Grand Strand, Santee Delta, and Sea Islands. These three distinct coastal landform regions make up South Carolina's coast. Compare and discuss the differences in these three landform regions. Using the scale bar, determine the distance in miles of each region. In what general direction is South Carolina's coastline oriented?

2. Study one of the State Base Map for the following: What is the drainage pattern for the Carolina Grand Strand area? How have the geologic processes and the location of the grand strand ridges been affected by the drainage pattern of the Waccamaw River? What are the other major rivers that drain into Winyah Bay?

3. Identify the barrier islands of Folly Beach, Seabrook Island, Fripp Island, Hunting, and Hilton Head. All have been developed commercially. Identify the barrier islands that have remained virtually untouched such as Bull Island and Capers Island. How can you account for the differences in developmental trends between these two groups of barrier islands? Why are these called barrier islands not remnant islands?

4. Locate the Santee Delta at the mouth of the river at Santee Point. Identify the capes that jut out into the ocean and the elongated spits which are narrow peninsulas of sand. How were these elongated spits formed? Are they stable or susceptible to change?

5. Trace the path of the Intracoastal Waterway starting at North Myrtle Beach as it parallels the coast. This is part of the transportation system used for maritime travel along the eastern seaboard. Follow this system to Savannah. Use the scale bar to determine the approximate length of the intercoastal waterway in South Carolina. What types of watercraft use this system? What commodities do you suppose are shipped by water? Why not by truck? Why do you suppose the waterway was built on the coast, and not further inland? Is any portion of the waterway man-made? If so, where?

ENRICHMENT ACTIVITIES

1. Discuss general physical events which have led to the formation of the Coastal Zone area. Explain the influence of the glacial era on present day terraces, both on the Coastal Plain and off the coast on the continental shelf. What is the age of the Coastal Zone of South Carolina? (refer to Study Site 1-6)

2. How do you suppose the grand strand landform has contributed to the tourist-based economy of the Myrtle Beach Grand Strand area?

3. Trace George Washington's Presidential visit to the Palmetto State as accounted in Study Site 1-8. As near as you can, outline the path that he took down the South Carolina coast. Why did he travel by water and not by land?

ACTIVITY B **SANTEE DELTA - COOPER RIVER SYSTEM**

Materials

1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Map, Shaded Relief	1:500,000
1	Santee Delta & Surrounding Areas (Study Site 9-5)	
1	South Carolina State Highway Primary System Map	
1	Package Tracing Paper	

Activities

1. Using the State of South Carolina Base Map or Shaded Relief Map, beginning with head waters, name the rivers flowing through South Carolina that make up the Santee River system. Outline the approximate boundaries of the watershed that depend on the Santee System for drainage. How is water used from the Santee system?

2. The Santee River system has several prominent reservoirs. Identify these and name the river systems involved with each reservoir. Why were the reservoirs built and how are they used? What are the results of these reservoirs on the Santee delta formation? Where are the sediments deposited that would have normally been deposited in the delta?

3. Locate the diversion canal near Pinopolis Dam. Using a South Carolina State Highway Primary System Map locate the rediversion canals near Russellville and St. Stevens. This canal was constructed to channel water back through the Santee River and on to the Santee Delta. Mark the location of the canals on the State of South Carolina Base Maps.

4. Using the map of Santee Delta & Surrounding Areas (Study Site 9-5), identify Georgetown, Waccamaw Neck, Pawleys Island, North Inlet, Intracoastal Waterway and the remnants left by the rice fields. How far inland do the rice fields begin? Why were rice fields not located on the ocean?

5. Using the same map and a piece of tracing paper, draw the Santee Delta. Include a legend to show distances. Identify different features that are characteristic of a typical delta. This includes elongated spits or narrow peninsulas of sand and capes which jut out into the ocean. Compare the Santee Delta to the mouth of other South Carolina rivers.

6. Describe the landform of the Santee Delta. Murphy, Minim, Crow, Cat, Cedar, Grace, and Cane are all islands that make up the Santee Delta. Locate these islands on the map. How high above sea level are these islands.

7. Where is the main channel for the Santee River? Trace the possible paths of the Santee River as the waters enter the ocean.

ENRICHMENT ACTIVITIES

1. Discuss the chronological changes to the Santee Delta landform. What man made events have threatened the Delta? How is this being rectified?

2. The Scenic Rivers Act passed by the Legislature authorized the South Carolina Water Resources Commission to take an inventory of all South Carolina rivers and identify those with unique historical, recreational or botanical characteristics. Research their findings on the Cooper River or other major port city rivers. How will these scenic rivers be protected?

ACTIVITY C SEA ISLAND DEPOSITION AND EROSION

Materials

1	NHAP Transparency Winyah Bay	1: 58,000
6	North Island 7.5 USGS Map, NOS Shoreline Movement Study (Study Site 9-6)	1: 24,000

Activities

1. Compare the NOS Shoreline Movement Study of North Island (Study Site 9-6) with the transparency of Winyah Bay. Has Town Creek undergone much change? Explain the pattern of changes over the last 100 year period.

2. Predict the shoreline of North Inlet in the year 2000, 2025, and 2050. Make appropriate drawings.

3. Using the NHAP transparency, identify the wash-over areas along the coast of North Island. What caused the wash-over areas? Identify the maritime forests on this transparency. Describe the terrain and vegetation that you would expect to see on North Island. How wide is the island?

4. Explain the movement of the water as it enters the ocean at North Inlet. What evidence do you see on the NHAP transparency of this action?

ENRICHMENT ACTIVITIES

1. Hurricanes are a constant threat to the coastal areas of South Carolina. Using the booklet **Hurricanes Affecting South Carolina**, plot the landfall area, where the eye of the storm passed over land for historical hurricanes. What is the difference between a tropical depression and a hurricane? Explain the five categories used in the Saffir/Simpson Hurricane Scale. How are Hazel, Gracie, and Hugo classified?

2. How are hurricanes assigned names. Why are girls' names usually used? Are boys' names ever used? Why? What are Cape Verde storms? Where is Cape Verde? What is the difference between a hurricane and a tornado? In a tornado, which does the most damage, the high winds, excessive rain, or the high tides? In a Hurricane?

3. Next time there is an approaching hurricane alert, use a hurricane tracking chart for plotting the coordinate points of the hurricane eye. Monitor the barometric pressure in your classroom by taking daily readings from a barometer. What is normal barometric pressure? What is considered high? Low? What happened to the barometric pressure when the hurricane was approaching?

4. Research newspapers to find out how Hazel in 1954, Gracie in 1959, or Hugo in 1989 affected the Carolina coast. Plot their paths. What climatic conditions cause a hurricane?

5. The intertidal zone has played an important part in the development of South Carolina's coast. Illustrate with a diagram the effect of the moon and the sun on the tides. Show the position of the sun, moon and earth during each phase of the moon. Explain how these positions affect daily tidal changes on South Carolina's coast. What is the worst position of the moon and sun to occur during a hurricane? At the South Carolina beaches, tide charts are usually available. Why are people interested in knowing when high and low tides will occur?

6. Explore recent legislation such as the **1977 Coastal Zone Management Act**, the **Barrier Island Act**, and the **1988 Beach Front Management Act**. What is the intent of the legislation and how will it affect coastal development? What have been some of the initiatives people have taken to alter the natural processes of coastal erosion and deposition? Explain the effect of jetties, sea walls, and beach nourishment. What is the "dead zone?"

7. Discuss how the **Greenhouse Effect** would impact on coastal landforms and the economy of South Carolina. If the sea level rises as it is predicated by scientists, what will be the effects? What actions are needed to reverse this process?

PLACES TO VISIT

- Plan several field trips to the coastal zone for further studies on the coastal landscape. South Carolina's coast has many state parks, national forests and wildlife refuges open to the public. *Silhouettes of Carolina*, published by the South Carolina Wildlife Magazine contains a comprehensive list of natural areas to visit in coastal South Carolina.

Field Trip Locations in the Area of the Study Site

- Bellefield Nature Center located on US Highway 17 just north of Georgetown offers excellent field studies for students to learn about salt marshes, barrier islands, coastal ecology, plankton, plantation heritage, archeology, and forest and marsh ecology. Year round classes and programs can be scheduled by calling (803)546-4623.

- Brookgreen Gardens located on US Highway 17 is three miles south of Murrells Inlet opposite Huntington Beach State Park. Educational programs specially tailored for student groups can be arranged by calling (803)237-4218.

- Huntington Beach State Park on US Highway 17 is located three miles South of Murrells Inlet opposite Brookgreen Gardens. This is the former part-time home of Archer and Anna Hyatt Huntington. It offers seasonal educational programs for student groups. Visits can be scheduled by calling (803)237-4440.

Field Trip Sites Located on the Coast

- St. Christopher Camp and Conference Center is located on Seabrook Island south of Charleston. This residential Barrier Island Environmental Education Center provides students with experiences that enable them to learn about the ocean, beach, forest, salt marsh, and fresh water plant and animal life. Groups can be scheduled by calling (803)768-0429.

- Coastal Zone Education Center located on Hilton Head Island offers field and laboratory instruction in all aspects of the marine sciences. Programs are tailored to specific individual classroom needs, ages, and educational levels. For information and reservations call (803)757-4848.

- South Carolina state parks and National Wildlife Refuges on the coast provide special purpose programs and schedule tours dealing with coastal education. Many of the programs provide class studies, field trips and "hands-on" activities. These include:

Myrtle Beach State Park South of Myrtle Beach	(803)238-5325 (803)238-5326
Hunting Island State Park East of Beaufort	(803)838-2011 (803)838-2152
Edisto Beach State Park Edisto Island	(803)869-2156 (803)869-2756
Cape Romain National Wildlife Refuge North of Charleston	(803)928-3368
Pinckney Island National Wildlife Refuge West of Hilton Head Island	(912)944-4415

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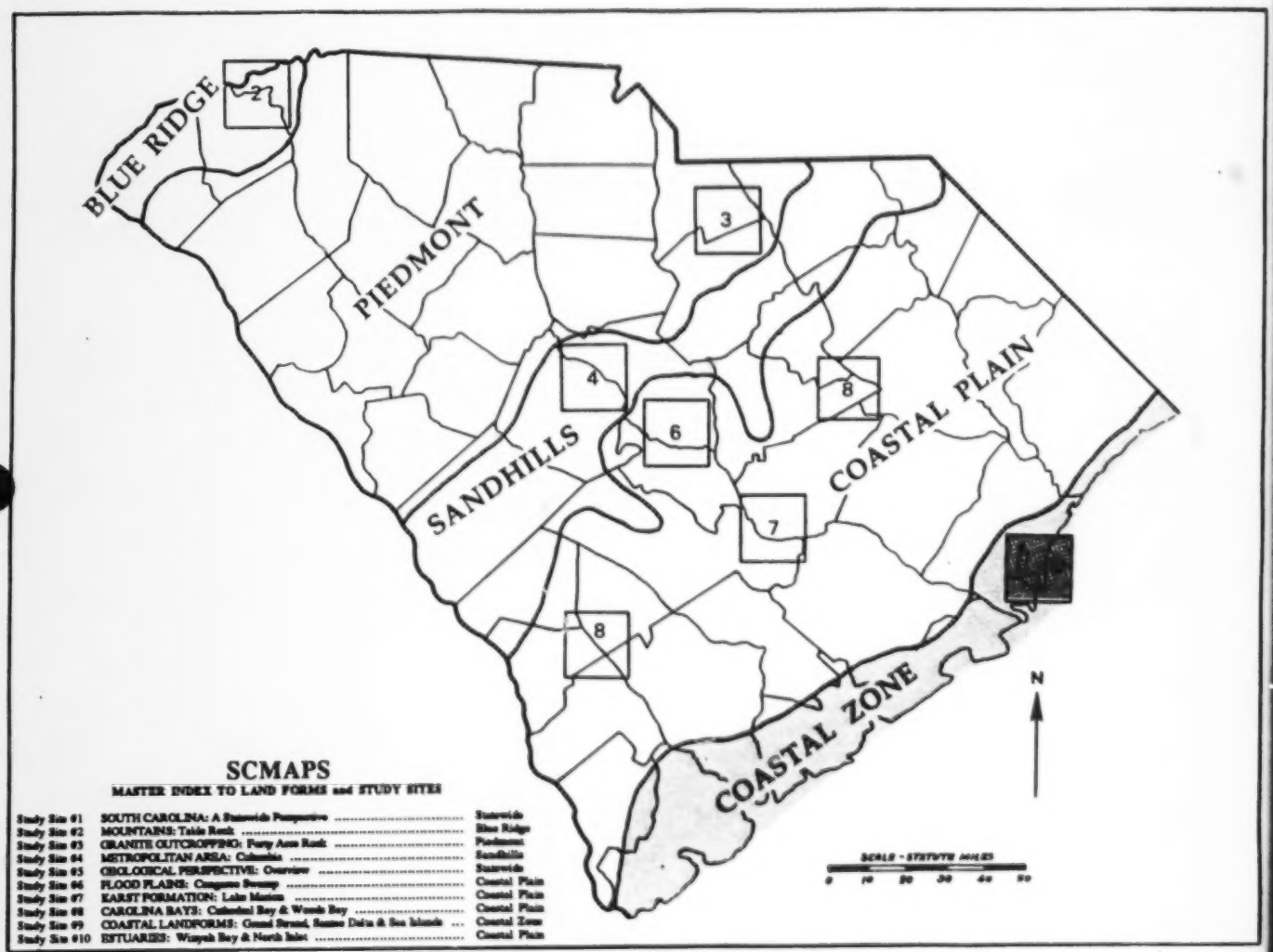
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SANDHILLS
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COASTAL ZONE

STUDY SITE 10

ESTUARIES: WINYAH BAY AND NORTH INLET

POWER THINKING

You are the first mate on the pirate Blackbeard's ship. You have just attacked and robbed two ships moving trade goods into the rice port of Georgetown. Now you are leaving Winyah Bay to outrun the British Navy, when a storm comes up. Where can you go, close by, to wait out the storm and to hide from the navy? (In selecting an appropriate map, first locate the Winyah Bay area on the State of South Carolina Base and Relief Maps, then use Waverly Mills and North Island Topographic Maps for specific places to hide.)

RATIONALE

The coastal bays, inlets, and estuaries of South Carolina have become an ever increasing attraction for vacationers, sportsmen, and naturalists, because the landscape is so different from the inland areas. Not only is the coastal zone attractive to summer vacationers, but it provides excellent wildlife habitat creating a year round haven for fishermen, hunters, bird watchers, and naturalists to enjoy. Natural harbors have favored the development of port cities such as Beaufort, Charleston, and Georgetown. Winyah Bay and its surrounding communities have been selected for this study site because it illustrates a typical coastal area with historical rice fields, inlets, bays, estuaries, grand strand beaches, and shifting barrier islands.

INSTRUCTIONAL OBJECTIVES

1. Recognize the impact of inlet, bay, and sound locations on the development of early and present settlements.

2. Understand the historical significance of the rice plantation era and recognize its impact on the current Coastal Zone landscape.

3. Examine the function and importance of estuaries in the seafood chain with emphasis placed on contributions of marsh plants and tides in this process.

4. Identify the major uses of the coastal zone's natural resources and assess the impact of these uses on the environment.

MATERIALS

1	NHAP Infrared Transparency Winyah Bay	1: 58,000
1	State of South Carolina Base Map with Highways	1:500,000
1	State of South Carolina Base Map, Shaded Relief	1:500,000
6	North Island, SC USGS Topographic Maps	1: 24,000
6	Waverly Mills SC USGS Topographic Maps	1: 24,000
1	Cross-section of a Typical Rice Trunk (insert)	Study Site 10-6

BACKGROUND INFORMATION

Historical Overview of the Coastal Zone

South Carolina's coastline has an interesting cultural history due to its proximity to abundant coastal resources, natural harbors, and large river systems. Indians settled on the coast taking advantage of plentiful fish, game, shellfish, and water resources. Huge oyster mounds found along the inlets and bays are one evidence of the Indian culture. Later, early settlers landed on the coast and established settlements on major rivers, which provided access into the interior land areas. The **Rice Plantation era depended on natural tidal action** and easy transportation of products. The port cities of **Charleston, Georgetown, and Beaufort** attest to the continuing attractiveness of **coastal areas as major industrial and transportation centers**. Presently, South Carolina's coast is experiencing rapid cultural development with emphasis on tourism and recreation.

Bays, Sounds, and Inlets

South Carolina's present-day coastal zone has been greatly influenced by major river systems that meet to form magnificent bays and sounds. Tidal inlets which frequently occur along the coast continue to shape the modern coastal landscape. Together the bays, sounds, and inlets divide our beach front into separate islands and contribute to their never-ending development and change.

Estuaries

Behind the Santee Delta and the barrier islands are the estuaries often called the nursery of the sea. These **estuaries provide breeding and feeding grounds for many sea creatures.** Marshes provide an abundant food supply for fisheries and shellfish, offer excellent habitat for waterfowl and other wildlife, serve as a filter for pollution, and furnish a protective barrier against storms from the ocean. **Estuaries are essential wetland areas, where fresh water from inland sources joins incoming salt water from the oceans.** Estuaries have an extremely dynamic ecosystem constantly changing in response to tidal action and varying amounts of fresh water due to seasonal and weather changes. Rivers, creeks, and smaller tributaries serve as arteries transporting nutrient-enriched materials from the uplands. These materials along with nutrients brought in by the tides provide the nourishment needed for many forms of marine life.

Several types of estuaries are found within the immediate coastal zone, ranging from predominantly salt water estuaries systems, to a mix of fresh and salt water (brackish water), to isolated fresh water estuaries. **Salt marshes are the most common type of estuary found in the coastal zone.** They contain a high salinity range and consist primarily of *spartina* plants. The food chain of the salt marsh eco-system is based upon the break-down of spartina into *detritus*, which provides a source of energy for *zooplankton* (microscopic aquatic animals), along with *phytoplankton* (microscopic aquatic plants). North Inlet and Pawleys Inlet marshes are excellent examples of salt marshes.

A second type of coastal estuary is the brackish-water marshes which are located in the less salty reaches of tidal rivers and marshes. This area has both salt and fresh water characteristics. The majority of these estuaries were used as rice field impoundments during the rice planting era. These estuaries can be easily recognized on the North Island Infrared Transparency because of the rectangular block patterns of the fields divided by dikes and ditches.

A third type of estuary contains fresh water. It contributes to the overall coastal marsh ecosystem by receiving rainwater which is drained from upland areas. These **freshwater estuaries** are recognized as **coastal swamps** and are mostly low lying depressions or river tributaries. The North Island and Waverly Mills topographic study site maps contain excellent examples of fresh water estuaries. These areas are mostly vegetated with deciduous water-tolerant tree species such as gums, cypress, and oaks.

South Carolina's coastal estuaries are highly productive and useful. Recent activities, however, are a constant threat to the well-being of these unique South Carolina features. Destruction of wetlands by housing and recreational developments, water quality changes due to pollution from industries, and overuse of natural resources are three major threats to this area.

Early Settlement

In mid-July 1526, Lucas Vasquenz de Ayllon with 500 Spanish colonists including men, women, and children, a few slaves, and 89 horses left Santo Domingo in six ships. They landed at the mouth of Cape Fear River, North Carolina, which they called the River Jordan. From there the group traveled down the coast to settle at Winyah Bay. The exact location of the settlement, San Miguel de Gualdape, is unknown, but historical evidence points to the mouth of the Gualdape River on the eastern shore of Winyah Bay. The Gualdape River is known today as the Pee Dee River.

Early in 1527, the settlers racked by disease, Indian attacks, and a slave revolt, headed home for Spain with 150 survivors. The former slaves stayed, thus becoming settlers in the areas 144 years before the founding of Charles Town (Charleston).

Indians

Upon arrival of early settlers, the Carolina Coastal Zone was occupied by many tribes of American Indians. The coast was well suited to the life of the Indians because of the abundance of natural resources, transportation, and mild climate. Oyster shell mounds called **middens** found along the coast are evidence of their presence. In the 1700s, as many as twenty separate tribes were found in the vicinity of the bays, sounds, and along the rivers. Many place names for towns, rivers, and bays bear the title of Indian tribes such as Winyah, Pee Dee, Waccamaw, and Sampits. Clashes with colonists, disease, slavery, and displacement all worked to eliminate the coastal tribes within less than two hundred years.

Pirates

Another Coastal Zone legacy of South Carolina was the pirate era. Piracy along the Carolina coast began soon after the first settlements were established and peaked with the prosperity of the colonial seaports. It has been estimated that in the early eighteenth century as many as 3000 pirates operated out of the Bahamas. Charleston was one of the busiest ports and was plagued by some of the fierce pirates in history. They used small fast vessels to seize larger slower merchant ships. Then they would escape into the coastal shallow areas where heavy warships could not follow. The shallow creeks and inlets along the coast made ideal haunts for pirates. North Inlet and Murrells Inlet became a haven for pirates as they could easily hide in these areas, always within range of abundant seafood and fresh water sources. Many tales have been told of pirates hiding treasures and never returning again to claim their bounty. Many were killed in sea battles or captured and hanged in Charleston or other port cities.

As part of South Carolina's history, many stories have been handed down. Pirates came from all walks of life. Some stories were told about well educated pirates while others were illiterate. Many were ne're do wells that wanted a fast buck. They all hung gruesome flags from their ship that were designed to invoke fear. Most of them were cruel and heartless and used alias names that were intimidating. One pirate from Charleston did not fit into any of the above categories. He was a well educated wealthy plantation owner from the Bahamas. He was given the nickname "Gentleman Pirate" as he bought his first ship and paid his crew wages instead of sharing the booty. He was not a seamen, as he had been in the British Army. His name was Major Stede Bonnet alias Captain Thomas. He is credited with the invention of "Walking the Plank." He raided the Carolina coastal areas and was hanged in Charleston while holding firmly to a flower bouquet given to him by a lady friend.

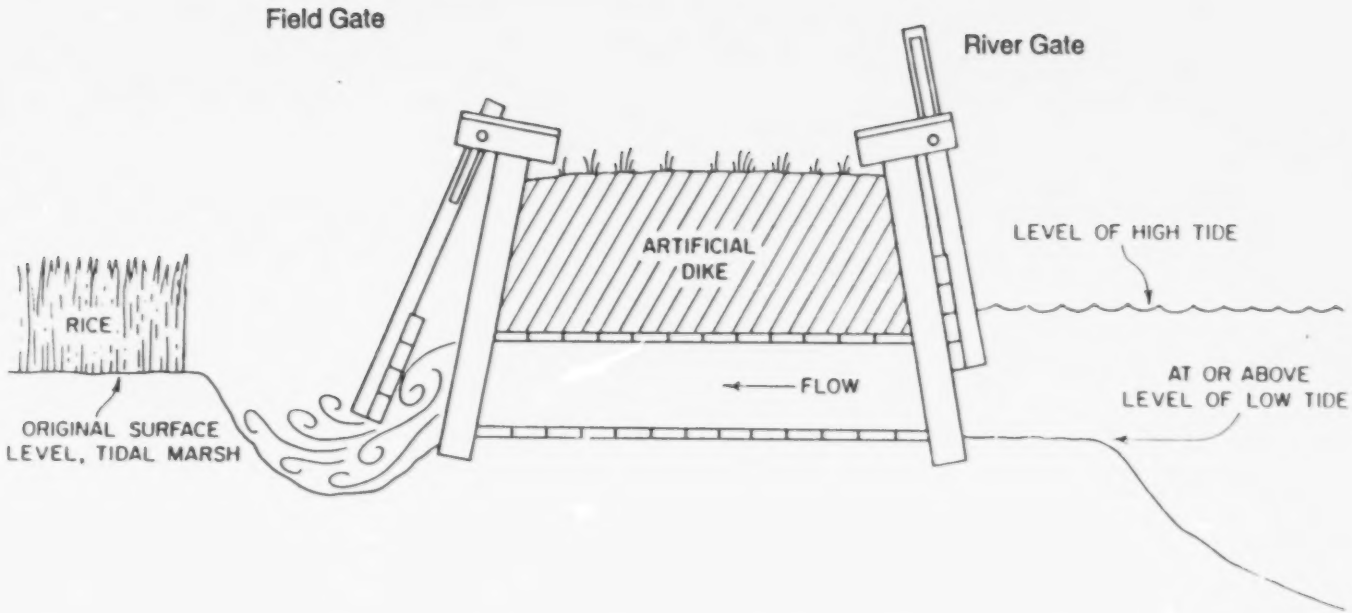
Of all the pirates that haunted the Carolina coasts, Captain Edward Teach alias **Blackbeard** was the most bloodthirsty and feared. With his forty cannon ship "Queen Anne's Revenge", Blackbeard and his seahawks preyed on coastal trade. On one raid he captured a succession of nine ships and held a group of passengers hostage in exchange for medicine. In a message to South Carolina's Governor Robert Johnson, Blackbeard threatened to kill all of the passengers and raid Charleston if his demands were not met. His demands were met and he sailed northward! Blackbeard was later killed by Virginia troops off the North Carolina coast. As a prize, his head was cut off and displayed while his body was fed to the sharks. Because of the threat to the coastal towns, Governor Johnson outfitted a strong naval force to apprehend the pirates. The golden era of piracy soon came to an end; however it remains as an important part of the history of South Carolina.

Rice Plantations

The **Rice Plantation era originated in the early 1700s** in South Carolina, with the Charleston and Georgetown area river basins becoming the major tidewater cultural areas. Evidence indicates that **rice seeds were brought by the blacks from Madagascar**, a large island off the coast of Africa. Rice cultivation was extremely labor intensive crop. The planter/landowners took advantage of abundant slave labor. Statistics indicate that the slaves greatly outnumbered other segments of the population. The rice era resulted in the establishment of large plantations and the cultural influence of African heritage.

In addition to bringing rice, the Afro-Americans brought with them many skills and traits necessary for survival. They knew how to make barrels, fish with large nets, carve canoes out of cypress logs, use herbs for medicine, weave baskets from reeds and grasses, and turn gourds into milk pails. Quickly they learned the trades necessary for becoming a bricklayer, barber, carpenter, blacksmith, sailor, and shoemaker. The Gullah language often called African English or Anglicized African evolved along the coastal areas of South Carolina and Georgia by the blacks combining their native language with English.

Along the rivers, plantation boundary lines were usually marked with ditches still clearly visible on infrared aerial photographs and topographic maps. In Waccamaw Neck, plantations were divided into narrow strips of land running west to east between Winyah Bay and the Atlantic Ocean. The banks of the rivers provided an excellent environment for rice cultivation. Tidewater rice culture took advantage of the ebb and flow of the tidal zone. High tides naturally raised the level of the fresh water in streams, followed by the low tide allowing the streams to flow normally as the water level dropped. **Early settlers used inland areas for rice plantations, which were just above the level of incursion of salt water and just below the upper limit of the tidal effect.** In the brackish-water estuaries or marshes, **strategically placed gates, dikes, ditches, and canals coupled with the energy of the tide allowed the water to pass back and forth between the field and the canal or river.** This provided the proper agricultural conditions for cultivating rice. Even though the Savannah, Combahee, Ashepoo, Edisto, and Cooper rivers became important tidal rice cultivation areas, it was the Waccamaw, Santee, Sampit, Black, and Pee Dee rivers that combined to make Georgetown the major rice producing region in South Carolina.



Idealized cross-section of a typical rice trunk. In this view, the outer gate has been raised to allow the fields to be flooded.

Reproduced from:

Lees, W.B. (1980). Limerick. Columbia, SC: Institute of Archeology and Anthropology.

Once the dikes, ditches, canals, and banks were constructed and fields cleared, rice trunks were built to allow water to pass over the rice fields at the proper time for cultivation of the plants. The illustration (Unit 10-6) taken from Charles Joyner's book shows how the fields were flooded and drained to permit proper conditions for rice cultivation. An explanation of the rice gates is taken from South Carolina: The Making of a Landscape by Kovacik and Winberry.

> *At the end of the trunk was a hanging gate, the field gate on one end and the river gate on the other. To flood a field, the river gate was raised. At high tide, the fresh water in the river rose and rushed into the raised river gate and through the trunk, pushed open the swinging field gate, and flowed into the field. When the tide ebbed and the water level in the river fell, the field gate slammed shut to prevent the water from flowing out of the fields and back into the river. After a succession of high tides the fields were inundated. To drain the fields, the process was reversed. The field gate was raised, the river gate lowered, and water moved out through the trunk at successive low tides.*

The tools used to cultivate rice were crude in terms of today's standards for farming in the United States. Most of the rice culture was drudgery and took a maximum amount of labor. The principal tool was the **hoe**. Other tools included the **open-ended gourd** for sowing the seed, **sickles** for harvesting the grain, **wooden flails** for threshing, and **mortars and pestles** for separating rice grains from the chaff. Rice cultivation required a large number of laborers with year round duties.

Each month of the year brought on chores for rice cultivation. In December and January the stubble was burned from the previous year. Next the fields had to be prepared by hoeing. The trunks, canals, and ditches had to be cleaned and repaired. Planting the crop began in March and continued through April by dropping seed rice into shallow trenches. Often a ball of clay was placed around each seed so that it would not float. Full moons were closely monitored so that the flooding of the fields at spring tide (period for high tides) would coincide with the sprouting of the rice. Water covered the rice fields for five days during **sprout flow**. Then the fields were drained during the next quarter moon phase, when there was a period of lower or neap tides. After fields were given two more hoeings, the rice fields were again flooded during the period called **harvest flow** and kept under water for six to eight weeks. During this time, the water was allowed to rise on the plants keeping the water level just below the heads of the growing rice stalks.

During the **harvest flow** which came in late August or early September, the fields were drained and the stalks were cut with sickles called rice hooks. The rice sheaves were bound, dried, and laid in parallel rows on a large sheet. Laborers began the task of separating the grain from the husk. Wooden flailing sticks were used to thresh the rice. Mortars were hollowed out of cypress pine logs and pestles were used for removing the husks and polishing the grain. Harvesting was finished in November, just in time to begin the cycle of rice culture over again in December. During the later period of rice cultivation, pounding mills were built along the rivers. Many are standing today as a reminder of the period of rice cultivation in the low country.

Summary

The South Carolina Coastal Zone offers a diversity of landforms with the bays, inlets, and estuaries providing the breeding and feeding grounds for many sea creatures. The pirates used the coastal area as hiding places between raids on Charleston. The early settlers ditched, diked, and dug canals for cultivating rice, which required an aquatic environment differing considerably from other crops. Now the Coastal Zone provides a haven for vacationers, sportsmen, and naturalists to enjoy the beautiful beaches, productive estuaries and coastal swamps.

ACTIVITY A **WINYAH BAY AND GEORGETOWN AREA**

Materials

1	State of South Carolina Base Map	1:500,000
1	State of South Carolina Base Map, Shaded Relief	1:500,000
6	North Island, SC USGS Topographic Maps	1: 24,000
6	Waverly Mills, SC USGS Topographic Maps	1: 24,000
1	Package Tracing Paper	

Activities

1. Identify on the South Carolina State Base Map with Highways or Relief the three major South Carolina ports. Make individual tracings of the rivers, inlets, bays, sounds, and estuaries that surround Georgetown, Charleston, or Beaufort. Explain the different characteristics of each. Indicate the names of each of the natural features you traced.

2. Identify the drainage pattern for Winyah Bay on the state base maps. Locate the major rivers flowing into Winyah Bay including the Waccamaw, Pee Dee, Little Pee Dee, Lynches, and Black Rivers. Divide the students into groups. Have each group select a major city in the Winyah Bay drainage area such as Bennettsville, Cheraw, Conway, Florence, Darlington, Dillon, Georgetown, Kershaw, Kingstree, and Marion and explain how the water drains from that city to the ocean.

3. Again using the State of South Carolina Base Maps, identify the direction and path of the water flowing through the Waccamaw River. Follow the path of the river to the ocean. Locate the mouth of Winyah Bay. What distinguishes a bay from an inlet?

4. Although the exact location is not known, Ayllon established the first European settlement in the United States at the mouth of the Pee Dee River (known then as the Gualdape River) on the eastern shore of Winyah Bay. Locate the approximate location for this settlement on either of the state base maps. Which city is located nearest this area?

5. On Ayllon's trip from the Cape Fear River, North Carolina, he followed the coast to Winyah Bay and then up the Waccamaw River. Using the state base maps, in what directions did Ayllon travel after leaving the Cape Fear River? Why did he travel up Winyah Bay before stopping? Why did Ayllon establish his settlement in the Winyah Bay area? What geographic features made Winyah Bay a good location?

6. Divide the class into two groups, the "Pirates" and the "Colonists." Using the state base map, the pirates must write a plan for raiding ships and cutting off trade to coastal ports. The Colonists must write a plan for protecting shipping from pirates. Compare the strengths and weaknesses of each plan. Who was victorious?

7. Divide the class into several pirate groups. Using the North Island or Waverly Mills Topographic Maps, each group must secretly hide a treasure somewhere on these study sites and write down clues for the other group to locate the treasure. Give coordinate points, distances, place names, directions, description of terrain using map reading skills. Choose areas that look promising for treasure hunting today.

ENRICHMENT ACTIVITIES

1. South Carolina is fortunate to have a coastline with many bays and harbors. How have these natural landform features stimulated the development of port cities. What goods are exported and imported to South Carolina? What natural resources have contributed to this shipping economy? Identify spin-off economic business and industries that have benefited from shipping.

2. Select a particular export commodity (i.e. soybeans or paper) and trace its route from production to consumption, using either the port city of Charleston or Georgetown as the destination.

3. Along Winyah Bay, both a paper mill and steel manufacturer have large plants. For each of these industries, compare the raw materials necessary for production, accessibility to shipping, and economic spin-offs factors that have contributed to the prosperity of the areas. What are the environmental issues facing this area? When do you achieve a balance between economic value and environmental concerns?

4. Look at Map 6 on page 89 in Kovacik and Winberry's book, *South Carolina: The Making of a Landscape*. Why do you think the slave population in Horry County never accounted for more than 50% of the total population while in Georgetown is was much greater?

5. Draw a typical food chain diagram for a salt water marsh i.e. North Inlet which is ranked as a high salinity tidal estuary. Construct a typical food chain for a rice field with brackish-water marsh on the Santee or Waccamaw River. Compare the results, noting the similarities and differences. Are the animal and plant life different? Do all three estuary types start the food chain with microscopic organisms? What is the composition of soil in these estuaries? Which plant life is found in abundance in each estuary type? What environmental benefits do estuaries provide? Why must we protect our South Carolina estuaries?

6. It was part of the Indian cultural to make oyster shell mounds called **middens** along the bays and inlets. Contrast the Indians' method of disposing of oyster shells by making mounds to our garbage disposal methods used today. How are these methods the same? Different? How are oyster shells disposed of today?

ACTIVITY B **WACCAMAW RIVER AND PAWLEYS ISLAND**

Materials

1	NHAP Transparency Winyah Bay	1: 58,000
6	North Island, SC Topographic Maps	1: 24,000
6	Waverly Mills, SC USGS Topographic Maps	1: 24,000

Activities

1. Compare the NHAP Infrared Transparency of Winyah Bay with the North Island Topographic Map. Identify all of the features you can distinguish on the maps. Locate and name *natural features* such as inlets, beaches, rivers, canals, and dikes, along with *cultural features* such as roads, houses, churches, plantations, and rice fields.

2. On the NHAP transparency, green foliage appears to be red because of the color shift in infrared photography. It was taken in the winter time when gums, cypress, and oaks have no foliage and evergreens such as pines were green. Use the different intensities of red to identify the three types of estuaries and a pine forest. The salt water marshes appear reddish. The brackish-water marshes or rice impoundments appear dark red, while the fresh water coastal swamps are even darker.

3. On the NHAP transparency and the North Island Topographic Map identify the evidence of past rice production activities?

4. Locate Pawleys Island on the Waverly Mills Topographic Map. This island was used extensively by plantation owners in the 1700s and 1800s for summer homes. Why did the people seek beach homes during the summer months? Locate Arundell Plantation on the Pee Dee River and trace the route used for traveling from it to Pawleys Island. Using both the North Island and Waverly Mills Topographic Maps, identify the present bridge, highway, and roads leading to the Pawleys Island beach resort. Why are there no rice fields in the Pawleys Island marshes?

5. One significant difference between Debidue Beach and Pawleys Island is the fact that Pawleys Island has been extensively developed. Note the purple area on the south end of Pawleys Island indicating the deposition of sand during the period between 1942 and 1973 when the map was revised. Is this a good location to build a beach house or condominium? Why?

6. The Waverly Mills map names several plantation sites still in existence. Locate and name these plantations. Discuss the strategic location of each of these plantations to rice fields, water transportation, and inland roads.

7. Spot elevation points are marked in brown by an "X" with the number nearby. What is the highest elevation on the Waverly Mills topographic map? Determine the elevation of several plantations. What would happen when the water level of this area rose 10 feet? 20 feet? In hurricane Hugo, the surge was 8-10 feet in this area. Using either the Waverly Mills or North Island Topographic maps, how much of the land was covered by water?

8. A bench mark is a reference point placed in the ground or on a stationary object by a surveyor identifying an elevation and position. These reference points are used to survey parcels of land. On the Waverly Mill Topographic Map, there are a number of bench markers along US 17 identified by "BM," a triangle, and the elevation number above mean sea level. Using the Waverly Mills Topographic Map, locate the BMs along US 17. What is the approximate elevation of US 17.

9. Using the North Island or Waverly Mills Topographic Maps and then the State of South Carolina Base Maps, why was escape virtually impossible? What were the problems they encounted in escaping from these plantations? Until the advent of highways, where could they go?

ENRICHMENT ACTIVITIES

1. In the early 1900s, Elizabeth Allston Pringle struggled to keep her plantation together by cultivating rice many years after the War Between the States had virtually ended the rice plantation era. Her plantation, Chicora Wood, was located up the Pee Dee River from Georgetown. Through two books, A Woman Rice Planter and Chronicles of Chicora Wood, Ms. Pringle gives a vivid account of the rice plantation era. Find out how the people lived, worked, and played on a plantation in that period of time.

2. How was rice cultivated by our early settlers? Explain to a classmate how rice trunks operated with hanging field and river gates during high and low tides. Why were the phases of the moon taken into consideration when operating these gates? What type of landform was used for rice fields, and why were they located inland off the isolated coastal salt marshes? How were Georgetown, Charleston, and similar port communities affected by the rice era? How did rice help these communities to eventually develop into major cities? Why do you suppose rice became a staple food in South Carolina? Who introduced rice to this area? Where is rice grown today?

3. How do estuaries serve as filtering systems for pollution and storm water? Is there a limit to the ability of estuaries to serve as filtering systems? Explain.

4. Research the life cycle of the shrimp. What part does the estuary play in this life cycle? What is the significance of the shrimp in the food chain?

5. Research the early introduction of rice culture to the United States by the Afro-Americans. A legend relates the tale that a ship from Madagascar in the 1600s was damaged by a storm and took refuge in Charleston. On board the ship was seed rice which was later planted. Locate Madagascar on a world map. In South Carolina One of the Fifty States on pages 160-171, Lewis P. Jones has documented the many skills and trades introduced into the United States by the Afro-Americans, explain in detail these contributions. What were the linguistic contributions of the Afro-Americans?

6. Wetlands legislation has been a prime issue for those protecting these fragile areas threatened by development, agriculture, and forestry. Wetlands include the state's marshes, swamps, bogs, and Carolina bays are recognized as ecologically critical. The functions which wetlands serve are flood control, ground water recharge, shelter and breeding grounds for a diversity of life, and recreation. Research the progress of wetlands legislation.

PLACES TO VISIT

- Bellefield Nature Center located on Highway 17 just North of Georgetown offers excellent field studies for students to learn about salt marshes, barrier islands, coastal ecology, plankton, plantation heritage and archeology, and forest and marsh ecology. Classes can be scheduled for programs by calling (803)546-4623.

- Brookgreen Gardens located on US Highway 17 is 3 miles South of Murrells Inlet opposite Huntington Beach State Park. Education programs specially tailored for student groups can be arranged by calling (803)237-4218.

- Huntington Beach State Park on US Highway 17 is three miles South of Murrells Inlet opposite Brookgreen Gardens. On the grounds is the former part-time home of Archer and Anna Hyatt Huntington. Now it offers seasonal education programs for student groups. Visits can be scheduled by calling (803)237-4440.

- The Rice Museum in Georgetown is located along the historic river front area. Open week days, programs can be scheduled by calling (803)546-7423.

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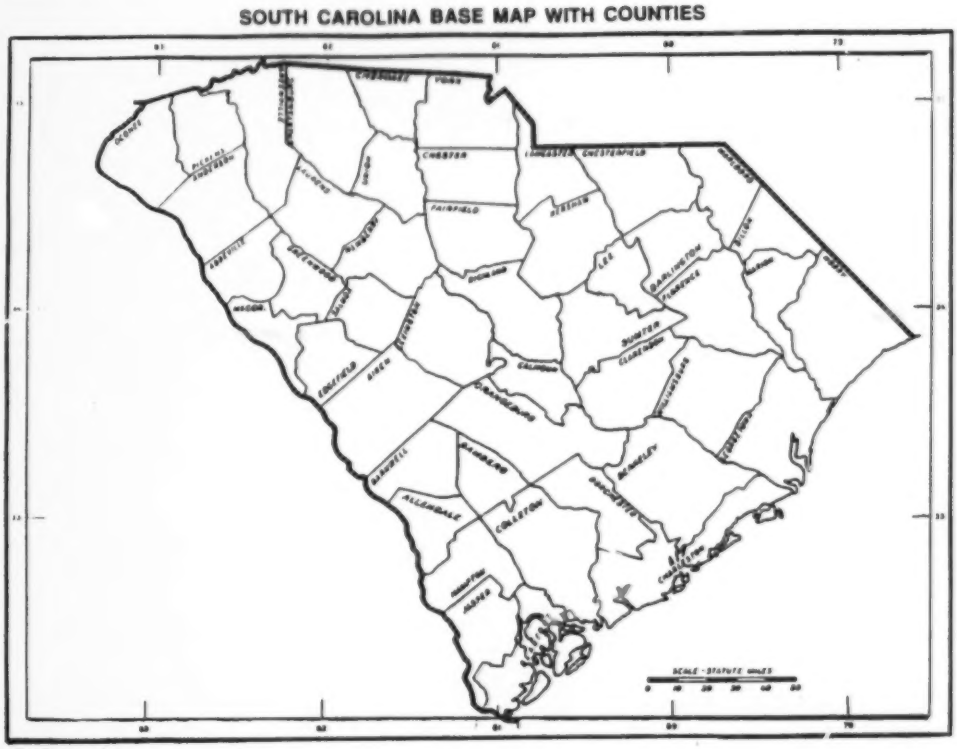
SOUTH CAROLINA BASE MAP WITH COUNTIES



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